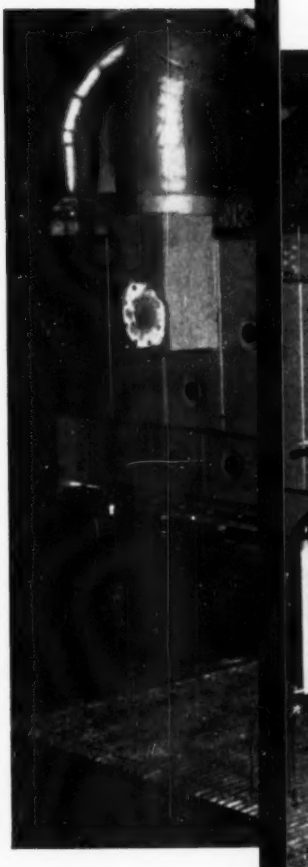
# DIESEL POWER

## AND DIESEL TRANSPORTATION

FEBRUARY, 1953

- ***Nordberg's "FSE" Engines***
- ***Applying Fuel Injection Equipment To Diesel Engines***

# How San Antonio's Mission Pumping Station assures FREE



PUMPS at Mission Pumping Station, San Antonio, Texas, are driven by three Fairbanks-Morse dual-fuel engines. The problem of maintaining the dependable, economical performance these engines were designed to deliver is solved by lubrication with *Texaco Ursa Oil*. Says Assistant Manager R. A. Thompson, Jr. –

> "During the two years these engines have been in service, *Texaco Ursa Oil* has kept them exceptionally clean – no sludge in crankcase, no carbon formations, and rings free in their grooves. Wear is negligible. We give *Texaco Ursa Oil* the lion's share of the credit for our low maintenance costs and low fuel consumption."

Whether you're operating Diesel, gas or dual-fuel engines, you can get a *Texaco Ursa Oil* to assure fine performance. There is a complete line of *Texaco Ursa Oils*, approved by leading engine builders and preferred by operators everywhere. In fact –

*For over 15 years, more stationary Diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.*

The first step toward better engine performance is to call in a Texaco Lubrication Engineer. Just contact the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

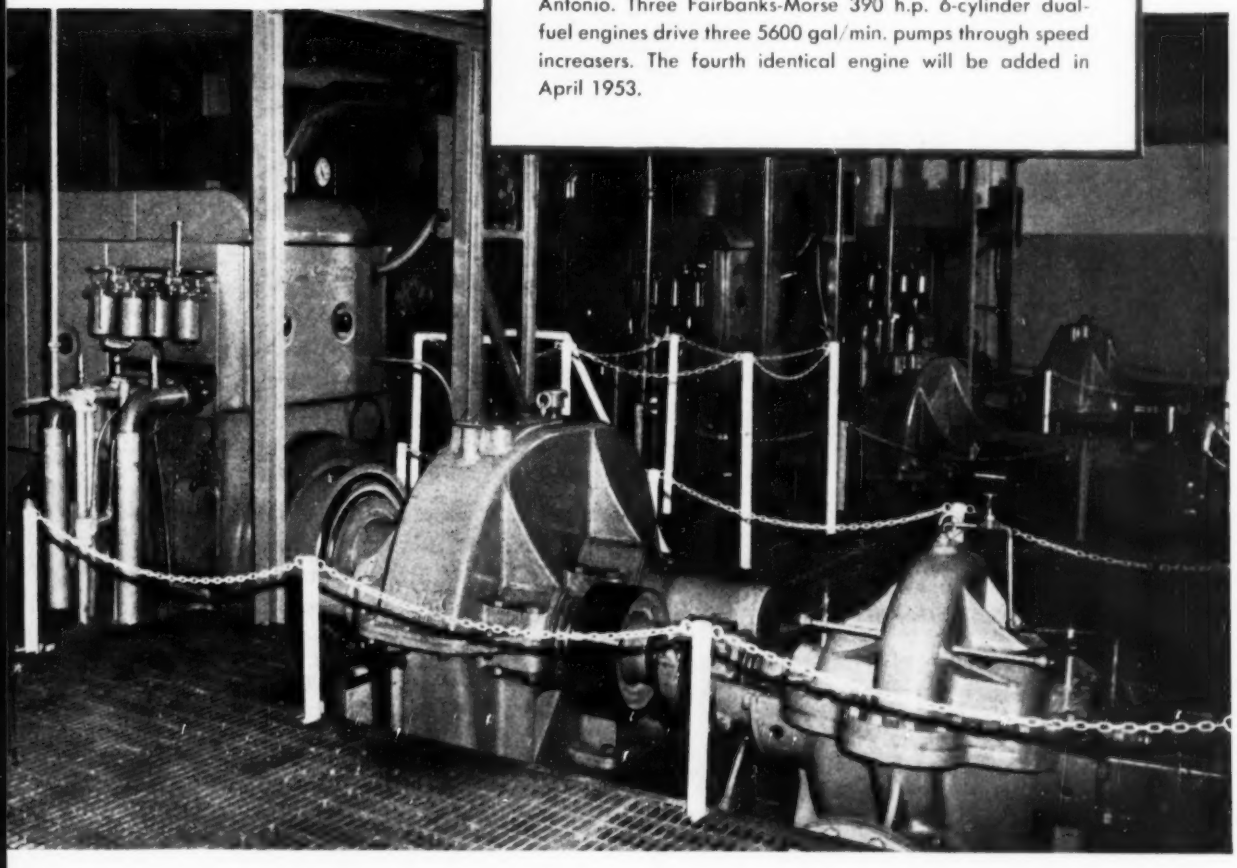
**TUNE IN** . . . TEXACO STAR THEATER starring MILTON BERLE, on television Tuesday nights. METROPOLITAN OPERA radio broadcasts Saturday afternoons.

TEXACO

DIESEL POWER and DIESEL TRANSPORTATION for Feb. 1953, Vol. XXXI, No. 2. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices at 192 Lexington Ave., New York 16, N. Y. Subscription rate: United States, $5.00 per year, single copies 35¢; Canada $4.00. Foreign $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange, Connecticut under Act of March 3, 1879.

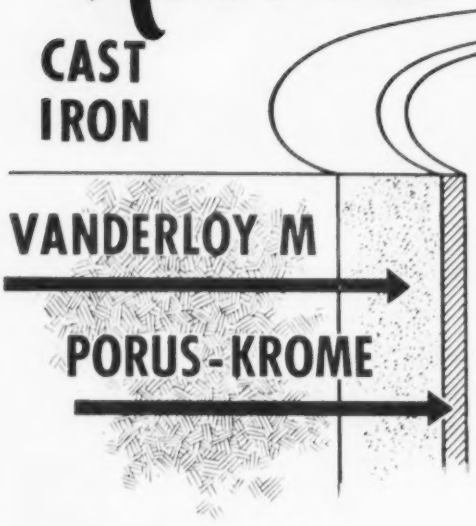
# RINGS

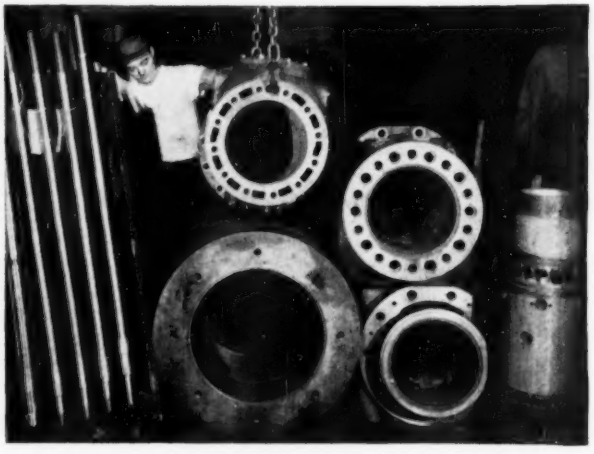
**MODEL OF EFFICIENCY.** Mission Pumping Station supplies water to the south side of the city of San Antonio. Three Fairbanks-Morse 390 h.p. 6-cylinder dual-fuel engines drive three 5600 gal/min. pumps through speed increasers. The fourth identical engine will be added in April 1953.



**URSA OILS** FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

# Reverse the Wear...



VAN DER HORST
TRADE MARK

* *PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

U. S. PATENTS
2,048,578, 2,314,604 and 2,412,698

Why bother to have your liners oversized? Reverse the effects of wear — have your liners Van der Horst processed!

With VANDERLOY M we can plate back any liner you have to original size — and with PORUS-KROME* we can keep it that way.

A PORUS-KROME liner outwears as many as four unprocessed liners. Meantime, it uses less lube and fuel oil, delivers more power and is much easier on rings.

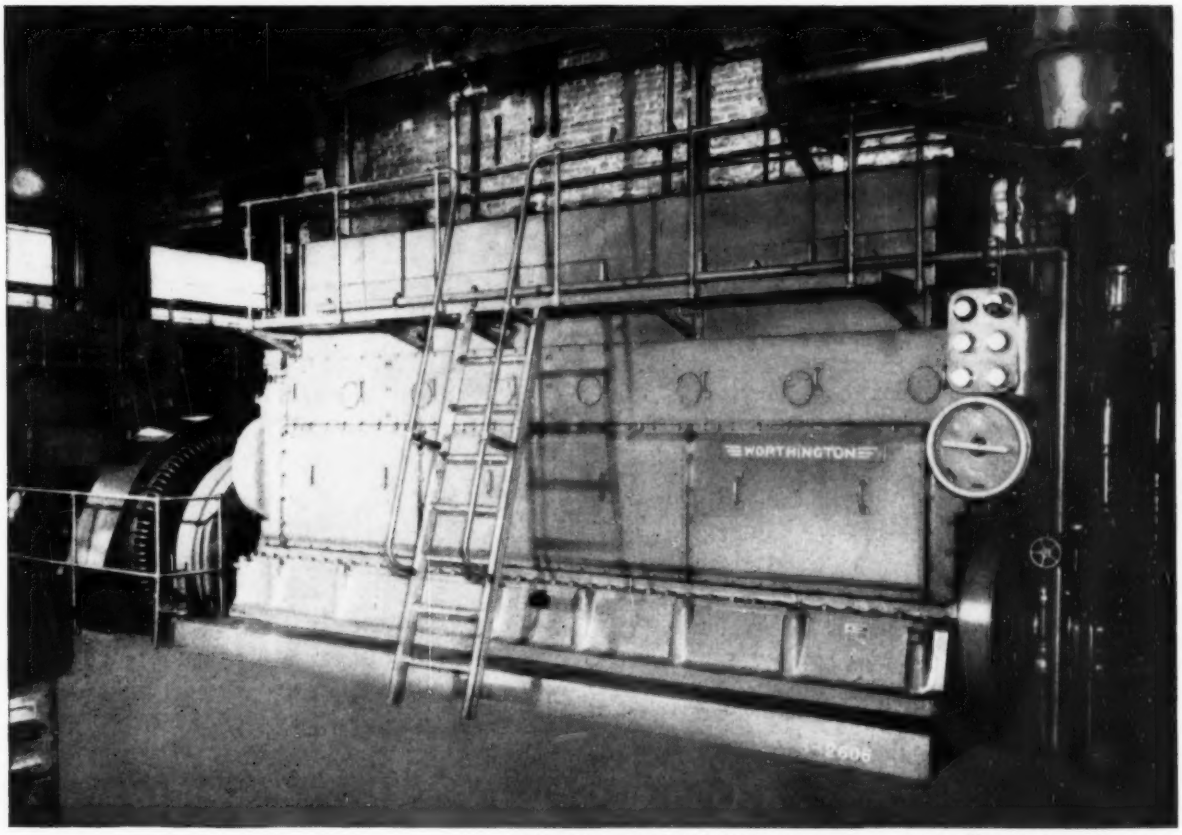
When such liners finally need replacing, simply slip in another set of Van der Horst Re-STANDARD-Sized liners — and send the worn ones back to us for renewal again.

Even liners you'd normally scrap are restored to original dimensions and each renewal pays pays for itself — several times over.

Of course the real profit comes when you eliminate the cost of stocking oversize parts — simply by having Van der Horst "reverse the wear" on all your liners. Let us show you how much can be saved by making this your standard practice.

W52-3D

**VAN DER HORST CORPORATION • OLEAN, N. Y.**




WORTHINGTON 1085-KW DIESEL ENGINE, is one of three Worthington engines now serving at Ford City, Pa., municipal power plant. This engine, during first 2 years of operation, logged 16,490 hrs. with average lube oil consumption of 5,400 hp hrs per gallon.

# Ford City, Pa.—Another "repeat" customer of Worthington Diesels

### *Borough officials take pride in power plant's operating economy during 16 years*

Sixteen years have passed since the first Worthington Diesel was installed in the municipal power-generation plant at Ford City, Pennsylvania.

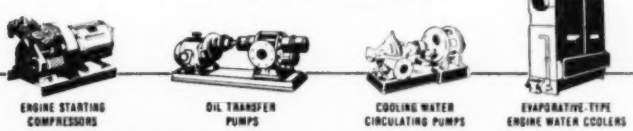
The latest installation—made in 1948—is a Worthington 1085-kw Diesel generator set. Other Worthington performers in the plant are the 300-kw unit installed in 1936 and the 462-kw unit installed in 1938.

Borough officials and the plant manager—who pride themselves on operating economy—tell us they now take for granted the dependability of their Worthington engines. Local consumers—some 6,000—have the low consumption of fuel oil and lube oil, as well as low maintenance expense, to thank for their economical rates.

Worthington's complete line of engines can give your municipal installation the most economical power no matter what fuel is used. For more data on modern Worthington engines—gas, Diesel, or dual-fuel—write Worthington Corporation, Engine Division, Buffalo, N. Y.

E.2.4

**Worthington-Built Auxiliaries**



ENGINE STARTING COMPRESSORS | OIL TRANSFER PUMPS | COOLING WATER CIRCULATING PUMPS | EVAPORATIVE-TYPE ENGINE WATER COOLERS

**Economical Continuous Power**—Diesel Engines, 150 to 2,100 hp . . . Gas Engines, 190 to 2,100 hp . . . Dual Fuel Engines, 150 to 2,100 hp.

**WORTHINGTON**
Engines

# Smooth Starts
## mean low operating costs

WHEN a rear-dump truck pulls away smoothly from a shovel with a 30-ton pay load — without jolts and jerks — it's sure to stay on the job longer with less down time.

Trucks equipped with Allison TORQMATIC converters and transmissions always start smoothly — because TORQMATIC DRIVES absorb these shocks instead of transmitting them to other truck parts.

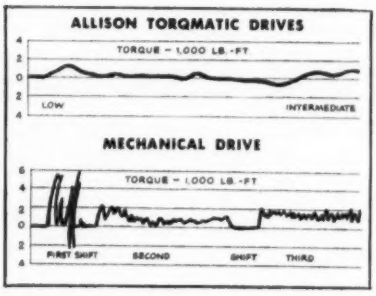
To demonstrate this, Allison engineers measured power-train shock loads in a large number of earth-moving, coal and ore-hauling trucks under both normal and extreme operating conditions. These charts show the results.

Trucks equipped with Allison TORQMATIC DRIVES showed starting shock loads four times less severe than trucks using mechanical drives. Furthermore, trucks equipped with Allison TORQMATIC DRIVES were *quick-shifted* at full throttle.

If you're operating off-highway trucks or other heavy-duty earth-moving equipment, specify Allison TORQMATIC DRIVES, the matched team of torque converter and hydraulic transmission. Ask your dealer, equipment or engine manufacturer for further information or write to:

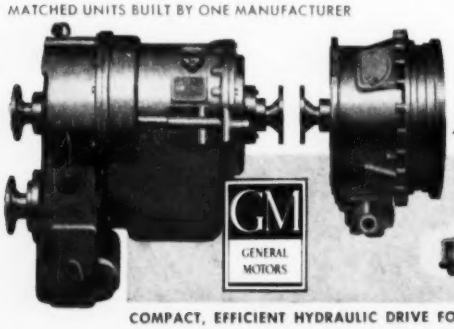
ALLISON *Division of* GENERAL MOTORS
Box 894SS, Indianapolis 6, Indiana

POWER-TRAIN SHOCK LOADS

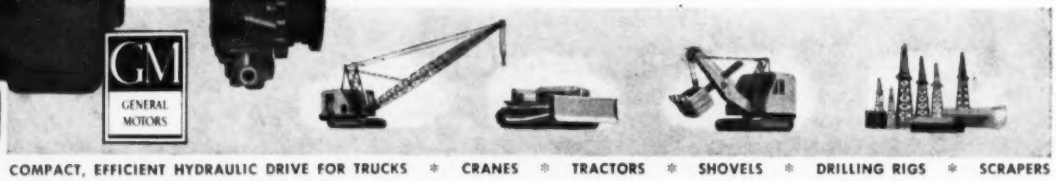



Note the jagged line — shock loads — as the mechanical drive truck pulls away from the shovel and shifts from first to second gear. Compare the smooth line — no harmful shock loads — for the truck equipped with Allison TORQMATIC DRIVES.

MATCHED UNITS BUILT BY ONE MANUFACTURER




Allison TORQMATIC DRIVES



COMPACT, EFFICIENT HYDRAULIC DRIVE FOR TRUCKS * CRANES * TRACTORS * SHOVELS * DRILLING RIGS * SCRAPERS

# Eaton Diesel Engine Valves, Bolts, and Studs

## Produced to meet the exacting requirements of Diesel Engine Service

A background of many years of experience as suppliers to the Diesel engine industry gives Eaton a thorough understanding of the peculiar problems encountered in this highly specialized field. Eaton has made far-reaching engineering contributions applicable to practically all types and sizes of Diesel engines. Greatly enlarged manufacturing facilities permit the production of highly-stressed main-bearing and connecting rod bolts with forged heads, under strict metallurgical and quality control.

EATON MANUFACTURING COMPANY

CLEVELAND, OHIO

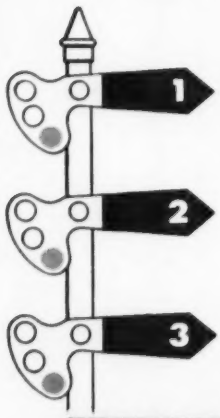
VALVE DIVISION: 9771 FRENCH ROAD • DETROIT 13, MICHIGAN

**PRODUCTS:** Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

# Gulf Dieselmotive Oil

## works 3 ways

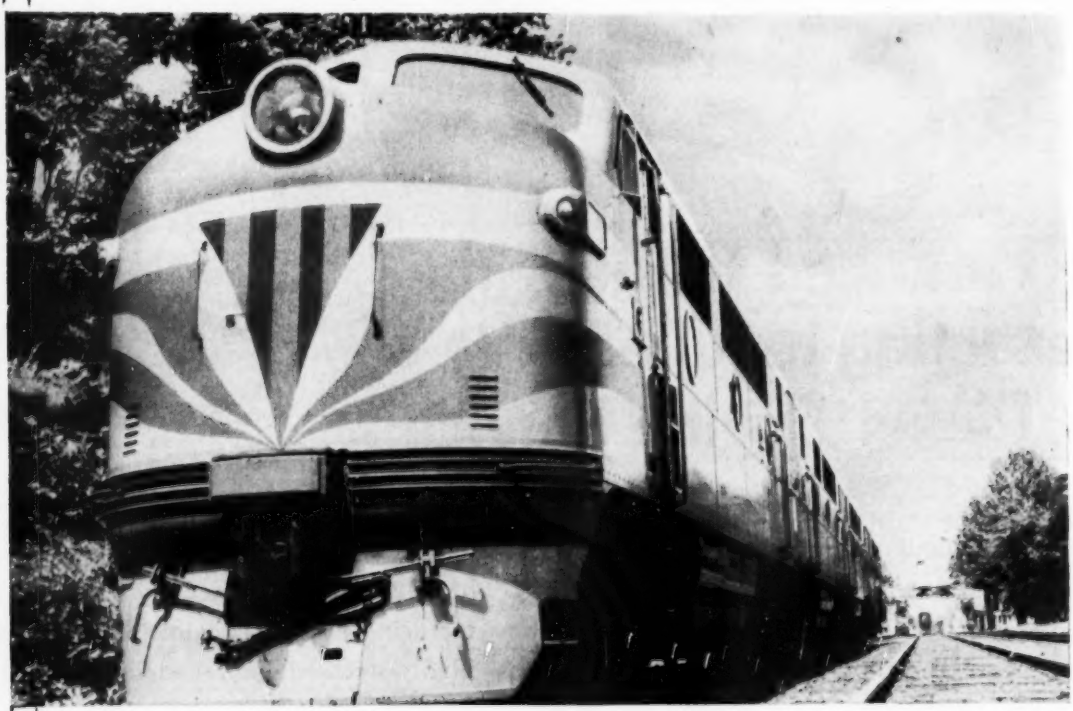
## to keep railway Diesels clean




**1** Effective detergent action fights piston ring belt deposits

**2** High stability retards sludging

**3** Base stock quality and refining methods prevent hard deposits on piston crowns



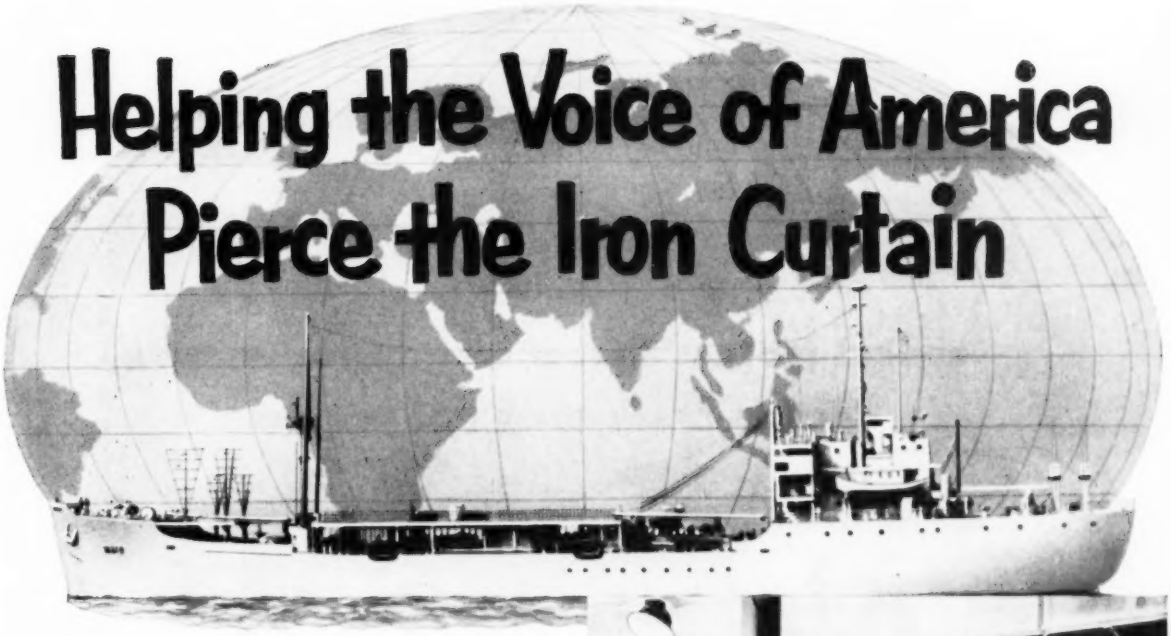
Gulf Dieselmotive Oil is ideal for railway Diesels. It protects against the accumulation of harmful deposits on compression and oil control rings, on piston crowns, and in ports. It cuts maintenance costs for engines with high power ratings, or for those which use fuels containing cracked materials or sulphur.

For further information on this quality oil, call in a Gulf Sales Engineer. Write, wire, or phone your nearest Gulf office.

GULF

**Gulf Oil Corporation · Gulf Refining Company · Pittsburgh 30, Pa.**

# Helping the Voice of America Pierce the Iron Curtain



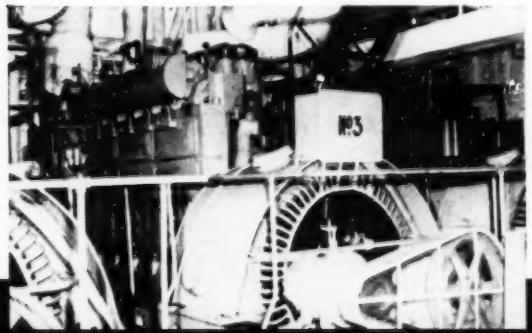
In a separate new auxiliary engine room, on the U.S. Coast Guard Cutter *Courier*, three 725 h.p. Enterprise diesels with Bendix* Fuel Injection equipment are playing an important part in helping to fight the cold war.

For this is the power plant that helps to transmit the Voice of America through the Iron Curtain to the captive peoples of the world.

To provide the electric power for the big transmitters, generating facilities must be capable of carrying difficult, variable loads with unvarying frequency, efficiently and dependably. Furthermore, the Enterprise diesels must continue to operate even if no better oil is available than residual fuel.

To help accomplish this important yet difficult task, Bendix Fuel Injection equipment was selected. In fact, wherever unusual performance standards are required, there is no better choice in fuel injection equipment than Bendix for complete dependability. *REG. U.S. PAT. OFF.

*Main transmitter room from which programs can be initiated or Voice of America broadcasts from land based points can be relayed out again with greatly amplified range and power.*



*Power for the 150,000 watt medium wave transmitter and two 35,000 watt short wave transmitters is supplied by three Enterprise diesel engines with Bendix Fuel Injection equipment.*

SCINTILLA MAGNETO DIVISION of

Bendix
AVIATION CORPORATION

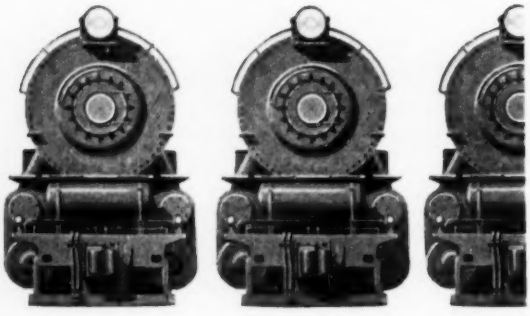
SIDNEY, NEW YORK

Western Market Office: 582 Market Street, San Francisco, Calif.
Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

# ONE

**General Motors Diesel freight locomotive does as much work per year as**

# 2½



**steam locomotives—because it hauls more tons faster and spends less time in the shop**

*but that's only half the story—*

**One-fifth ounce of fuel oil hauls one ton of freight one mile when burned in a General Motors Diesel locomotive**

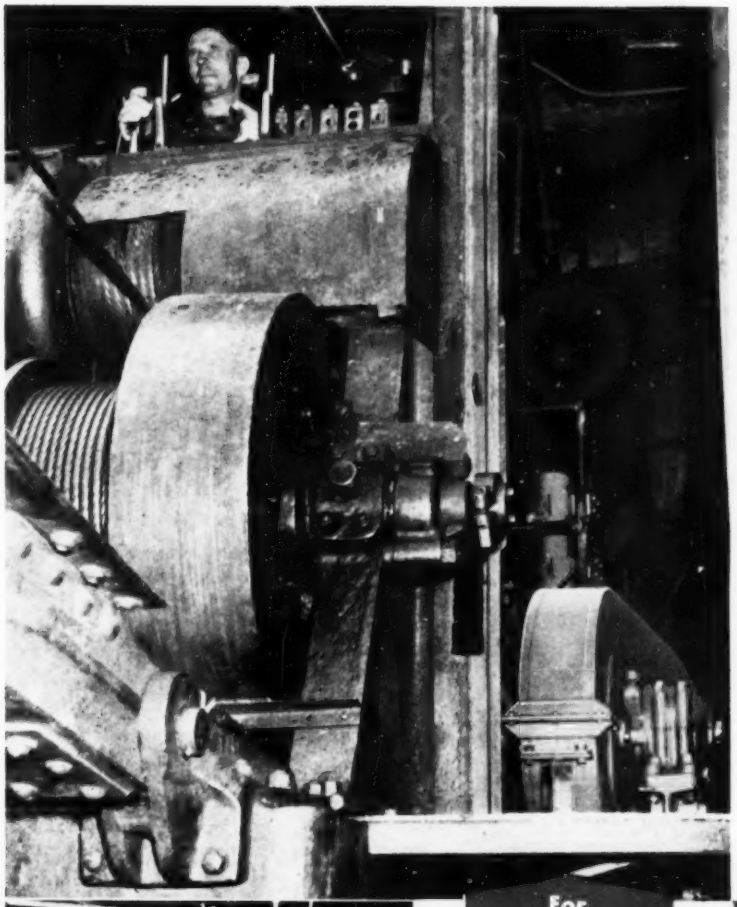
—five times as far as the same amount of fuel in an oil-burning steam locomotive

**To conserve fuel** / *AND GET MORE WORK DONE* **America needs more Diesels!**

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS

LA GRANGE, ILLINOIS • In Canada: GENERAL MOTORS DIESEL, LTD., LONDON, ONTARIO

# Why it pays to choose diesel auxiliary drives from LINK-BELT's complete chain line



## LINK-BELT offers you the right chain for your drive requirements

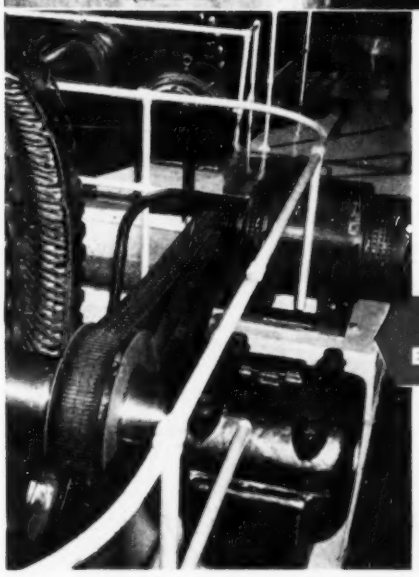
Whether it's a conversion, exciter, power take-off or any other auxiliary drive—there's a Link-Belt chain that meets the specific demands of each type of diesel service. You get the *one* chain that gives you the most economical power transmission . . . efficiently . . . at proper speeds.

That's why—if you plan to utilize diesel power in any way—you'll find it pays to call in a Link-Belt power transmission engineer. Working with a complete line and backed by Link-Belt's broad experience, he can recommend the drive that best meets your exact requirements.

LINK-BELT

CHAIN DRIVES

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13,095

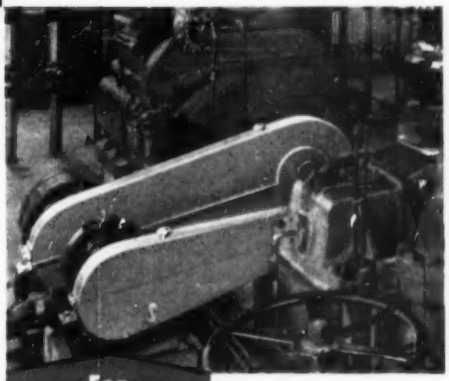


**For Conversion**

In converting this 1916 steam-operated locomotive crane to diesel power, Link-Belt Silverstreak Silent Chain was chosen as the drive. It provides positive, tooth-to-tooth action with the assurance of years of continuous, economical service.

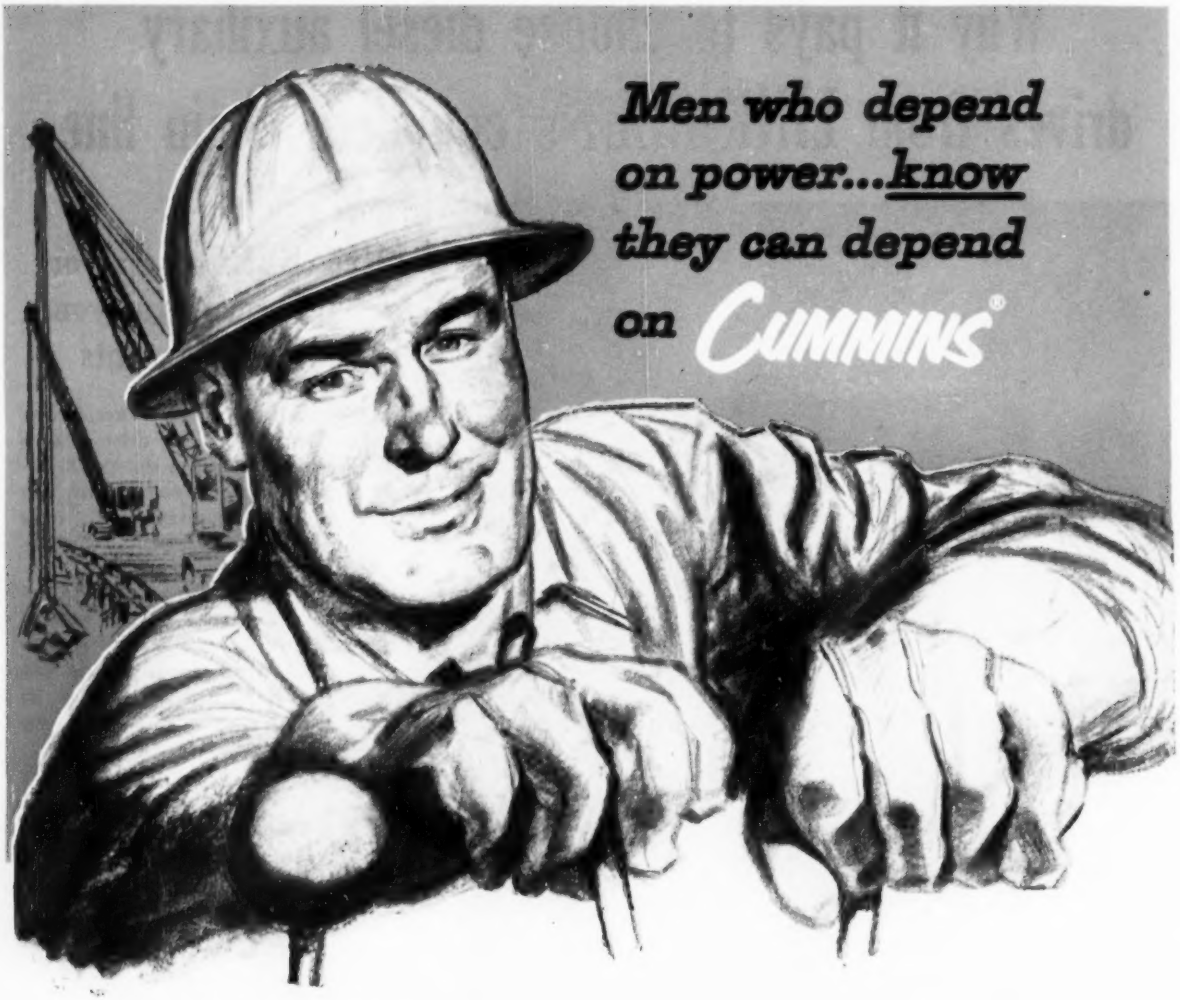
**For Exciter Drives**

Full exciter rpm is transmitted by this Link-Belt Silverstreak Silent Chain drive. Chain meshes with sprocket teeth—no possibility of slippage.



**For Power Take-off**

Link-Belt Silverstreak Silent Chain provides the drives from diesel engines to pumps at pipeline booster station.




## CUMMINS DIESELS *are engineered to make light work of tough jobs*

Ask any one of thousands of power users! He'll tell you that Cummins Diesels are standouts wherever they work . . . that they lead the pack with more work done at lower cost, with superb performance in roughest going.

With a lightweight, high-speed (60-600 h.p.) Cummins Diesel, your fuel costs are lower than with any other engine in general use today. This is true because of the economy in fuel injection and metering provided by Cummins' exclusive fuel system . . . because of the inherent savings made possible by four cycle diesel design.

Maintenance costs are slashed, too. Extra care in engineering, manufacture and testing adds thousands of hours of trouble-free operation . . . keeps "down time" at a minimum. Contact your Cummins dealer. He's a diesel power specialist—ready to show you how to apply Cummins savings to your jobs.

C-109

**CUMMINS ENGINE COMPANY, INC.,** Columbus, Indiana
*Export:* Cummins Diesel Export Corporation, Columbus, Indiana, U.S.A. • Cable: CUMDIEX

**CUMMINS**

***Leaders* in rugged, lightweight, high-speed diesel power!**

# Perfected at Last!

## Johnson
## ALUMINUM-ON-STEEL SLEEVE BEARINGS

JOHNSON BRONZE PRODUCES ALL TYPES OF SLEEVE BEARINGS

BRONZE-ON-STEEL
copper lead
STEEL BACK
babbitt lined
BRONZE BACK
babbitt lined
CAST BRONZE
plain or graphited
SHEET BRONZE
plain or graphited
ALUMINUM ALLOY
LEDALOYL
powder metallurgy

Are you one of the engineers who have been searching for a bearing metal with higher strength, higher load capacity and resistance to high engine temperatures? Improvements in machine design to reduce unit cost or improve efficiency often require greater loads on the bearings. Now you may design to use sleeve bearings with properties never available before.

These roll-bonded Aluminum-on-Steel Bearings may be used for loads up to 4000 P.S.I., yet have good conformability, good resistance to shaft wear, good resistance to corrosion, adequate seizure resistance and good resistance to fatigue. Tests prove that the bond to the steel back is as strong as the metal itself. These properties make Johnson Aluminum-on-Steel Bearings new high-load, high-speed bearings with a great future for high-load internal combustion engines. Write for full information.

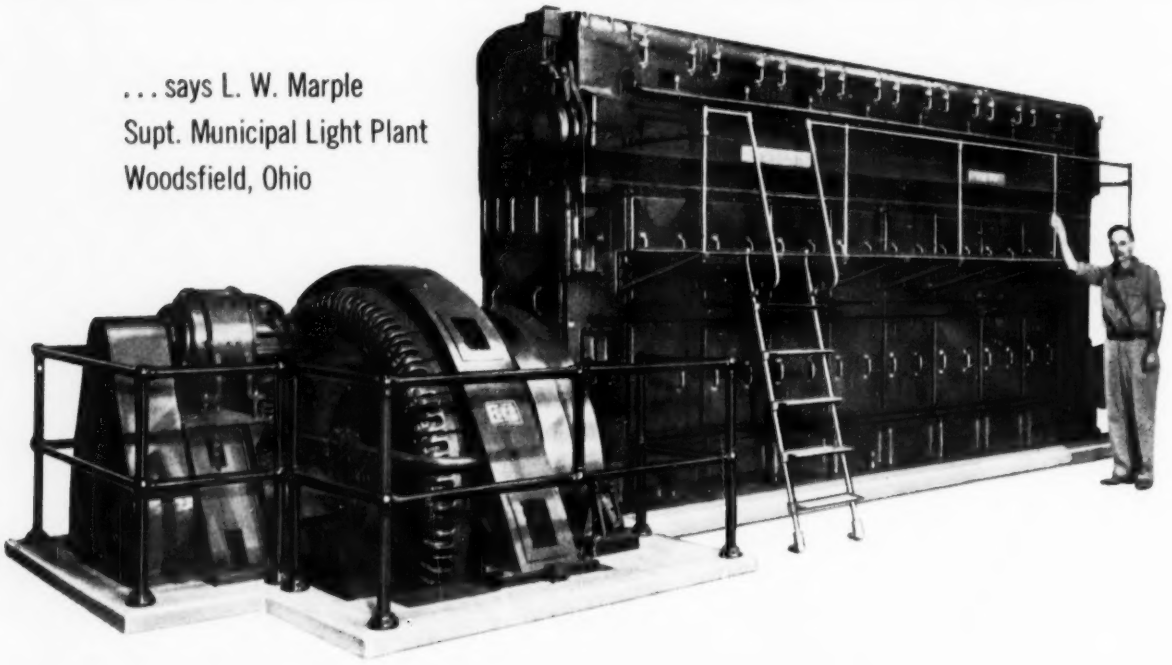
JOHNSON BRONZE COMPANY
470 South Mill Street • New Castle, Pennsylvania

**JOHNSON JB BEARINGS**
*Sleeve-Type*

Sleeve Bearing Headquarters Since 1901

# "No More Sticking Rings..."

... says L. W. Marple
Supt. Municipal Light Plant
Woodsfield, Ohio



● "Because of the lubricating oil we were previously using," says Mr. Marple, "sticking rings and carbon build-up were persistent problems on our three Fairbanks-Morse Model 32-E diesels.

"Three years ago, at the recommendation of one of your lubrication engineers, we switched to Sinclair GASCON® Oil D – HD.

"GASCON D – HD has cleared up our troubles... no more sticking or broken rings... no more carbon build-up, even though our load factor has increased. The result is a considerable savings in maintenance costs.

"We are also getting outstanding results with GASCON in our new 875 H.P. National Superior Dual Fuel Engine."

Perhaps a Sinclair Lubrication Engineer can solve *your* lubrication problems. Call your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

**SINCLAIR**

**DIESEL**

**LUBRICANTS**

save wear and replacements

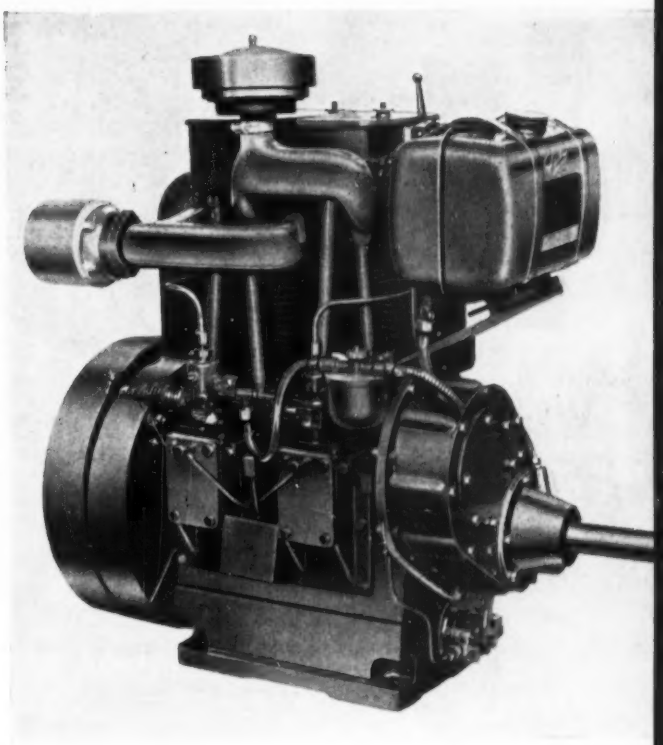
# PETTER

# DIESEL ENGINES

## AIR-COOLED · WATER-COOLED

## From
## 3 H.P. TO 40 H.P.
## LOW COST
## POWER UNITS FOR

- *MARINE AUXILIARIES*
- *GENERATORS*
- *PUMPING EQUIPMENT*
- *COMPRESSORS*
- *REFRIGERATION*
- *OIL FIELD EQUIPMENT*
- *MINING EQUIPMENT*
- *AGRICULTURE MACHINERY*



**PETTER RUGGED POWER UNITS**

Give you:
Reliability, Low Maintenance Costs
and Low Operating Cost—
only 8/10 Cent/HP/Hour.

Spare Parts & Service Available
World-Wide for more than
300,000 Petter Diesels now in use
—prompt deliveries.

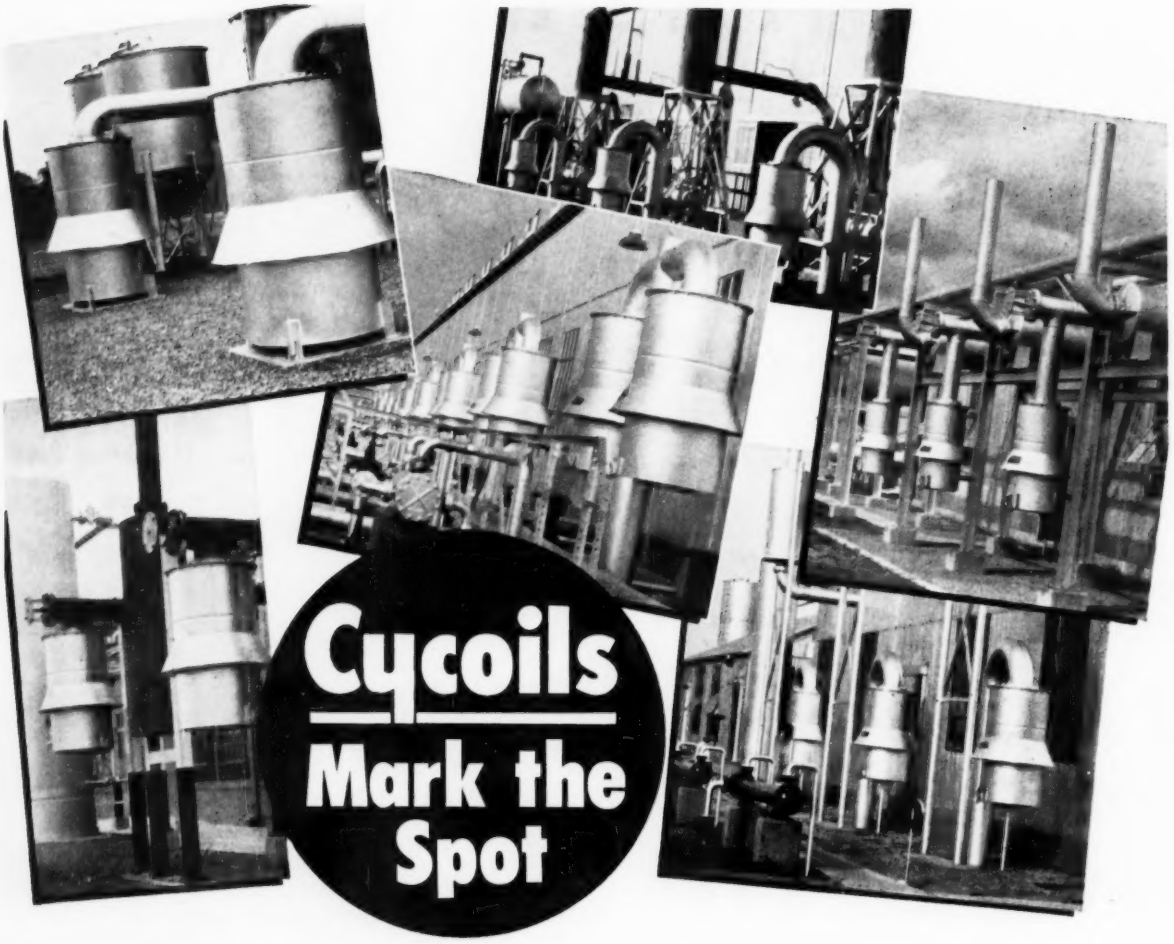
*Write for information, still few choice Distributorships Open.*

# PETTER

*Inquire at your local Petter Distributor or Dealer.*

**ENGINE DIVISION OF BRUSH ABOE INC.**

**EMPIRE STATE BUILDING**
**350 5TH AVE. • NEW YORK 1 • N•Y**




## Where Engines and Compressors Enjoy Complete Dust Protection

Such spots are numbered by the hundreds. Nor are all of them confined to the "dust bowl" areas of the nation. Find a cost-minded management that recognizes how dust damage contributes to engine down-time and repairs and you'll find dependable Cycoil Oil Bath Air Cleaners on the job.

What's the secret of Cycoil's industry-wide acceptance? They're designed to fight for every particle of dust. Thorough mixing of oil with the intake air at the start results in over 90% of the dust content being trapped before it even reaches the Cycoil's filter pads. Then comes the final cleaning action of the filter pads for removal of the remaining 10%. Net result—approximately 100% clean air.

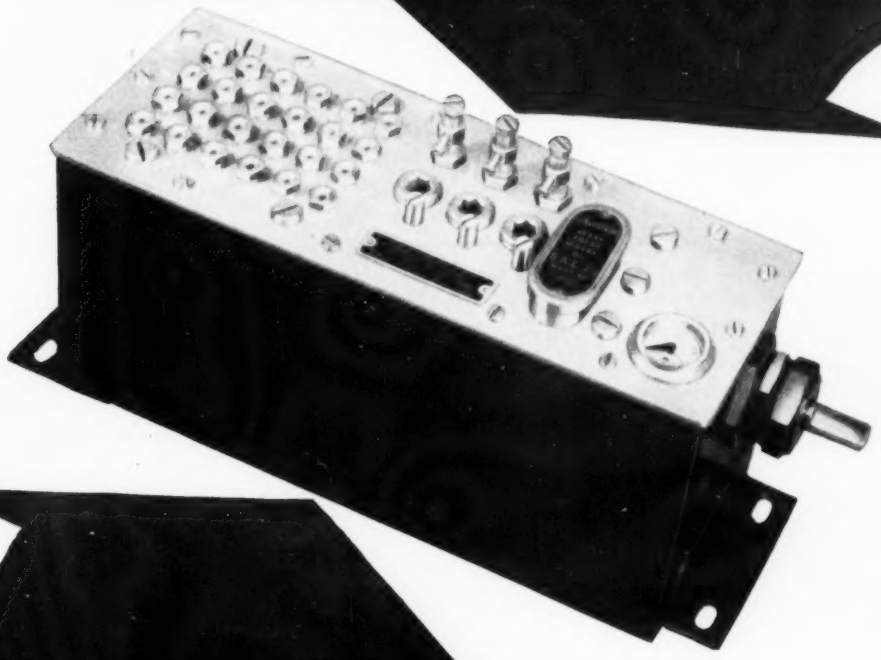
Why not get a firsthand report from the folks who really keep a running score on Cycoil performance? Write us today for list of representative users and complete Cycoil data.

AAF **American Air Filter**
COMPANY, INC.

445 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.

# MADISON-KIPP

# *Fresh Oil* LUBRICATORS



## THE MOST DEPENDABLE OILING SYSTEM EVER DEVELOPED!

## MEASURED FEED DROP BY DROP FED UNDER PRESSURE!

MACHINE performance is in direct relation to the quality of the oiling system! And that's why builders of America's finest machine tools, work engines and compressors specify Madison-Kipp "Fresh Oil" Lubricators as original standard equipment . . . because they provide the most dependable oiling system ever developed . . . measured feed, drop by drop, fed under pressure. There are six models to meet almost every application requirement. Illustrated is the Model FD. Please address all inquiries to the home office in Madison, Wisconsin.

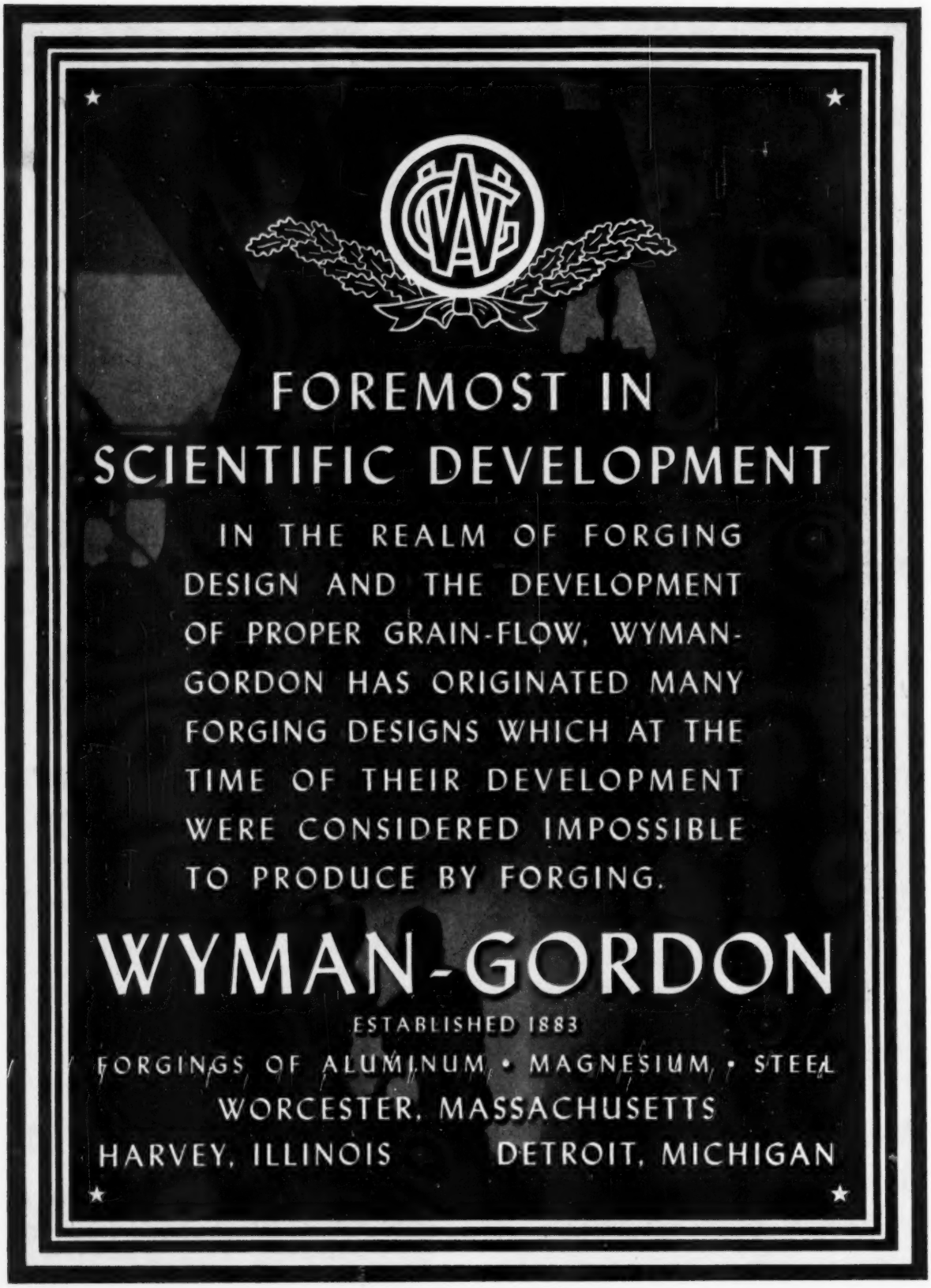
## MADISON-KIPP CORPORATION

**205 WAUBESA STREET, MADISON 10, WIS., U.S.A.**

ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

*WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.*

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS


FOREMOST IN
SCIENTIFIC DEVELOPMENT
IN THE REALM OF FORGING DESIGN AND THE DEVELOPMENT OF PROPER GRAIN-FLOW, WYMAN-GORDON HAS ORIGINATED MANY FORGING DESIGNS WHICH AT THE TIME OF THEIR DEVELOPMENT WERE CONSIDERED IMPOSSIBLE TO PRODUCE BY FORGING.
WYMAN-GORDON
ESTABLISHED 1883
FORGINGS OF ALUMINUM • MAGNESIUM • STEEL
WORCESTER, MASSACHUSETTS
HARVEY, ILLINOIS
DETROIT, MICHIGAN

# THIS IS THE DIESEL

## for any job from 16 H.P. up

When it comes to *pulling power*—and that means *paying power* in tractors, tugs and tillers as well as trucks—the General Motors 2-cycle Diesel is in a class by itself.

This engine's high torque output and rapid acceleration enable GM Diesel powered equipment to outpull and outwork other machines in *applications from 16 H.P. up.*

Producing power at *every* piston downstroke, instead of every other downstroke as do 4-cycle Diesels, the GM Diesel is smoother running, faster accelerating and more powerful for its size. It fits in approximately the same space as industrial gasoline engines of comparable horsepower—*and produces more power from less fuel!*

Ask your GM Diesel distributor to tell you how *this* Diesel can step up your production and cut your costs on mobile, portable or stationary installations.

*Single Engines . . . 16 to 275 H.P. Multiple Units . . . Up to 840 H.P.*

**DETROIT DIESEL**
ENGINE DIVISION
GENERAL MOTORS • DETROIT 28, MICHIGAN

GM
GENERAL MOTORS
DIESEL POWER

# Why leading diesel engine builders say—

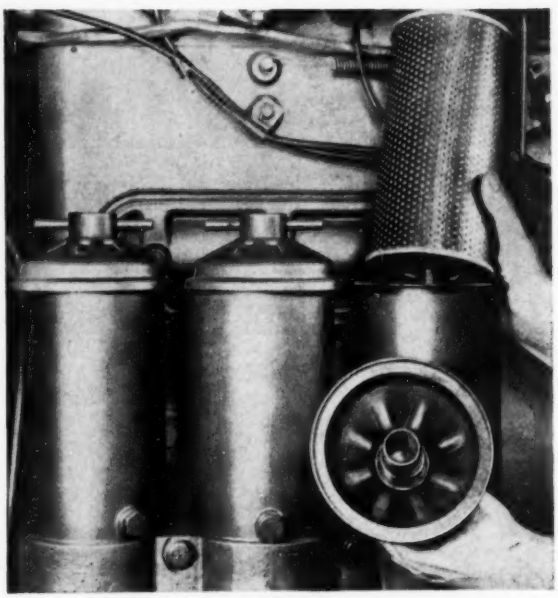
# It's *Purolator** for Full-Flow!

- **Full-flow rates within practical filter dimensions:** Purolator's famous "accordion-pleated" Micronic* filter element has up to ten times more filtering area than old-style filters—gives high flow rates in a minimum of space.
- **Ultra-micronic filtration:** High flow rates are, of course, meaningless unless effective filtration is maintained, too. Electron micrographs prove that the Purolator Micronic filter stops particles down to *submicrons*—.0000039 in.!
- **Maximum dirt storage capacity:** The pleated design of the Micronic filter element provides many times more dirt storage space than old-style filters. This important advantage means uniform, efficient performance and a lengthy service life.
- **Minimum pressure drop:** The Purolator Micronic filter element introduces a remarkably small pressure drop in the lubricating system . . . permitting pumps of practical size and simple type.
- **Will not remove or absorb additives:** With Purolator Micronic filtration, you keep *all* the oil quality you pay for. The Micronic filter element will not strip additives . . . an important advantage with HD and heat-resistant oils

Modern engines with full-flow lube systems . . . which filter *all* the oil at each pass through the engine . . . demand the best in filters. And most leading makers of diesel engines and vehicles agree that the best is *Purolator** . . . a fact proved over and over by their own impartial tests.

The story's the same with gasoline engines, too! The world's best known producers of passenger cars, trucks, tractors, earth-moving equipment, and stationary engines have found Purolators best . . . and install them as standard factory equipment.

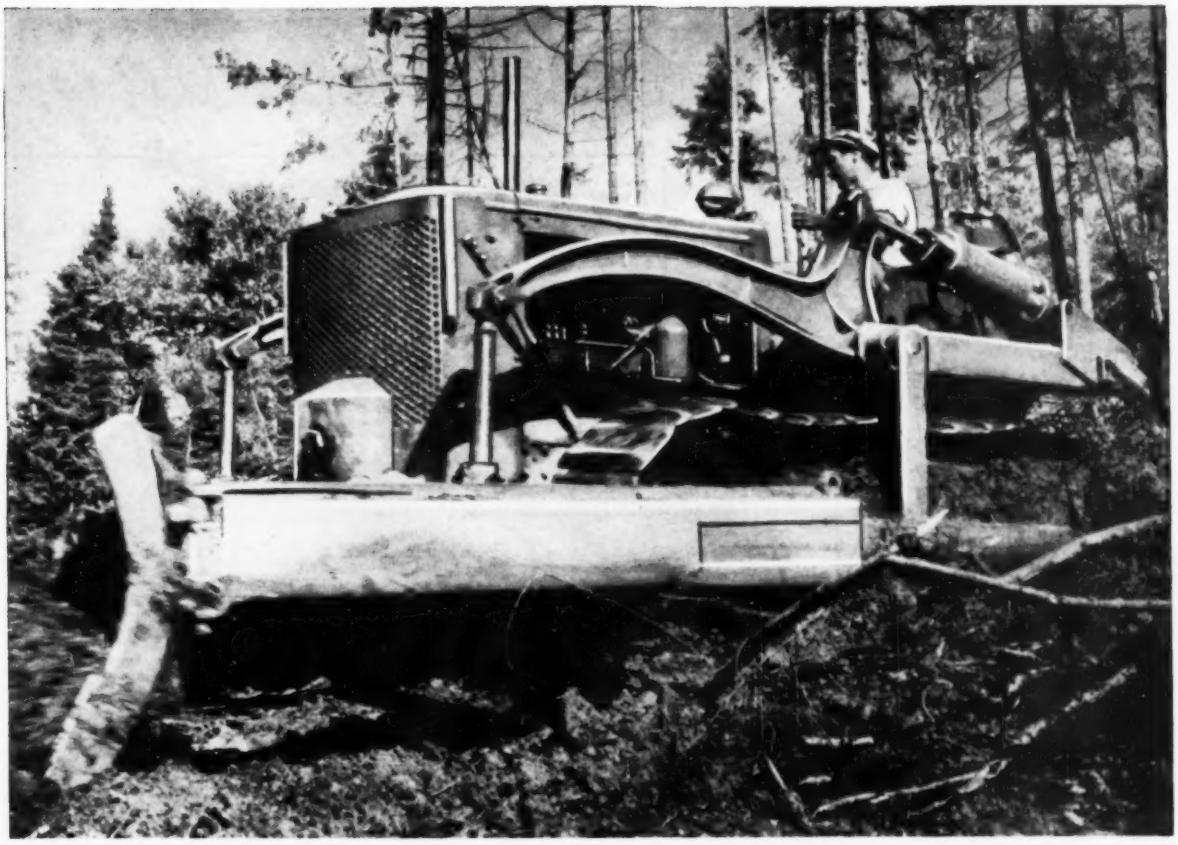
If you are contemplating new designs or modifications of existing ones, remember . . . there's a well-engineered and use-tested Purolator for *any* filter application, including fuel oil, gasoline, hydraulic fluid, and water. Write for the Purolator catalog issued for your special field.



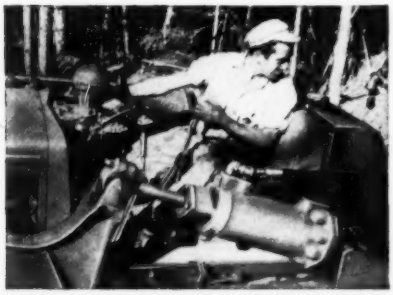
**Purolator Micronic Filters** in a typical Diesel full-flow installation. Although the Purolator Micronic filter elements measure only 4½ in. by 9 in., *each one filters 9 gallons of oil per minute*, giving a total of 27 g.p.m. for the complete filter unit.

PUROLATOR PRODUCTS, INC.
Rahway, New Jersey, and Toronto, Ontario, Canada
Factory Branch Offices: Chicago, Detroit, Los Angeles
*Reg. U.S. Pat. Off.

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"



BESIDES CUTTING OUT ROADS, Riendeau uses his TD 14 to push his truck and a 15-ton load through quagmire road sections.



RIENDEAU HANDLES BULLDOZER HIMSELF. He says: "I've had first-hand experience with the terrific performance these highest quality Cities Service Products deliver."

# New Hampshire Logger Cuts Truck Roads Through Forest!

Oscar Riendeau of Berlin, N. H., has been hauling logs for about 15 years. To get his lumber out of densely overgrown New England forests, Riendeau has to cut his own truck roads. He carves out his twisting, turning truck roads with an International TD 14 Diesel . . . powered by Cities Service #2 Diesel Fuel! . . . lubricated with Cities Service Lubricants!

Says Riendeau: "I use Cities Service Products throughout my operation . . . diesel fuels, lubricants, gasolene, and even tires. These high quality, dependable products have kept my equipment at work full time under really rugged conditions. I heartily recommend them for any earth moving or trucking operation."

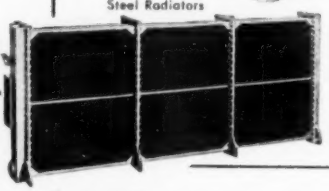
Why not try Cities Service Fuels and Lubricants in your operation?

**CITIES SERVICE**

QUALITY PETROLEUM PRODUCTS

# YOUNG *All the Way!*

## DIESEL LOCOMOTIVE COOLING

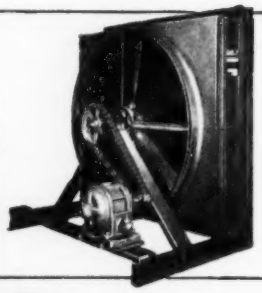


Removable and Fixed Tube Bundle, Shell and Tube Heat Exchangers

"MONO-WELD" Heavy-Duty Steel Radiators

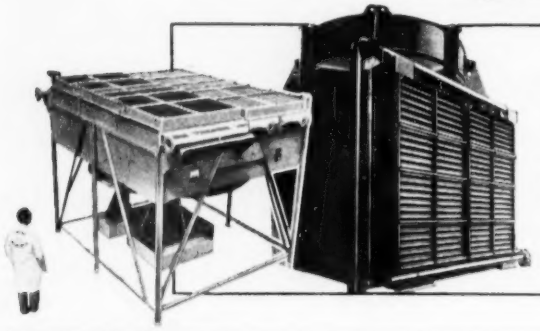
The combination of Young "MONO-WELD" radiators and heat exchangers offers heat transfer equipment that combines to provide proper, efficient cooling. "MONO-WELD" construction insures long life with steel single unit tanks, steel side members, and proper core selection. Young heat exchangers give maximum heat transfer per unit volume, with minimum weight.

## GAS, GASOLINE, DIESEL ENGINE FLUID COOLING



Young "FULL FLOW" and "STANDARD SERIES" Jacket Water Coolers

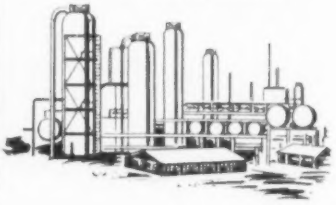
Young units offer a complete variety of cooling surfaces, compact, rugged design, welded steel construction. Vertical water flow, steel channel side members, steel side supports for cores, *press-formed heavyweight non-ferrous headers*, complete accessories, versatility of components to meet all requirements.



Young "HC" (left) and "VAD" Vertical Air Discharge Units

These units offer vertical air discharge—not affected by wind direction—efficient operation, full size plenum chambers, efficient air handling equipment, simple rugged structure of frame and metal work, proper heat transfer surface for any application required.

## GAS, GASOLINE, DIESEL ENGINE FLUID COOLING AND CONDENSING



Requirements for jacket water, lube oil, torque convertor or other specialized cooling may be met with the wide range of radiators and other products manufactured by Young. To fit specific requirements, use of proper materials, surfaces and accessories provide maximum heat transfer per unit volume of available space with minimum weight.

## POWER PLANT AND SPECIALIZED COOLING

# YOUNG

HEAT TRANSFER PRODUCTS FOR AUTOMOTIVE AND INDUSTRIAL APPLICATIONS.

HEATING, COOLING, AND AIR CONDITIONING PRODUCTS FOR HOME AND INDUSTRY.

T.M. REG. U.S. PAT. OFF.

**YOUNG RADIATOR COMPANY**

Dept. 413-B • RACINE, WISCONSIN

Factories at Racine, Wisconsin, and Mattoon, Illinois

**YOUNG ALL The Way . . .**

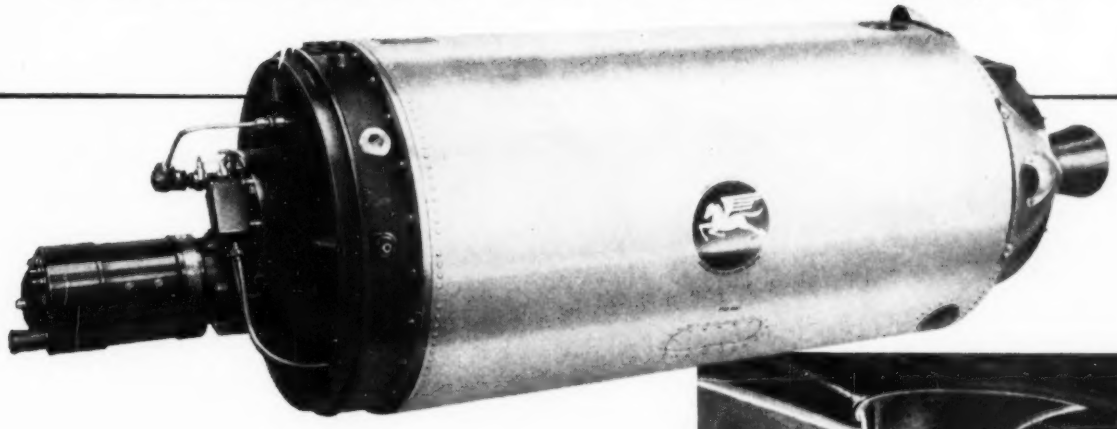
provides complete heat transfer products for any requirement. Complete facilities for manufacture of component parts, a *complete* selection of all core types, engineering and production know-how coupled with progressive research both in laboratory and field assure the most efficient in heat transfer equipment.

***Complete detailed information will be sent on request.***

# NEW HIGH IN SPECIALIZED

# *POWER*

## 3 LBS. THRUST FROM 1 LB. WEIGHT



**The J-44 Monocoque Turbo-Jet Engine...**
**Designed and Built by Fairchild**

One of the most compact engines in its power class ever produced is the Fairchild J-44 Monocoque Turbo-Jet. Only 72 inches in length, 22 inches in diameter and weighing only 300 pounds, the J-44 delivers a thrust of 1000 pounds.

Another example of a Fairchild design which met difficult and exacting specifications, the J-44 typifies the creative engineering ability of the Fairchild Engine Division.

Right now, the Fairchild J-44 Monocoque Turbo-Jet is being produced exclusively for the Armed Services. When conditions permit, this mighty midget will become available to boost payloads and lower operating costs of airline transports and other aircraft.

ENGINE AND AIRPLANE CORPORATION
**FAIRCHILD**
*Engine Division*
FARMINGDALE, N. Y.

**Aircraft Division**
Hagerstown, Md.

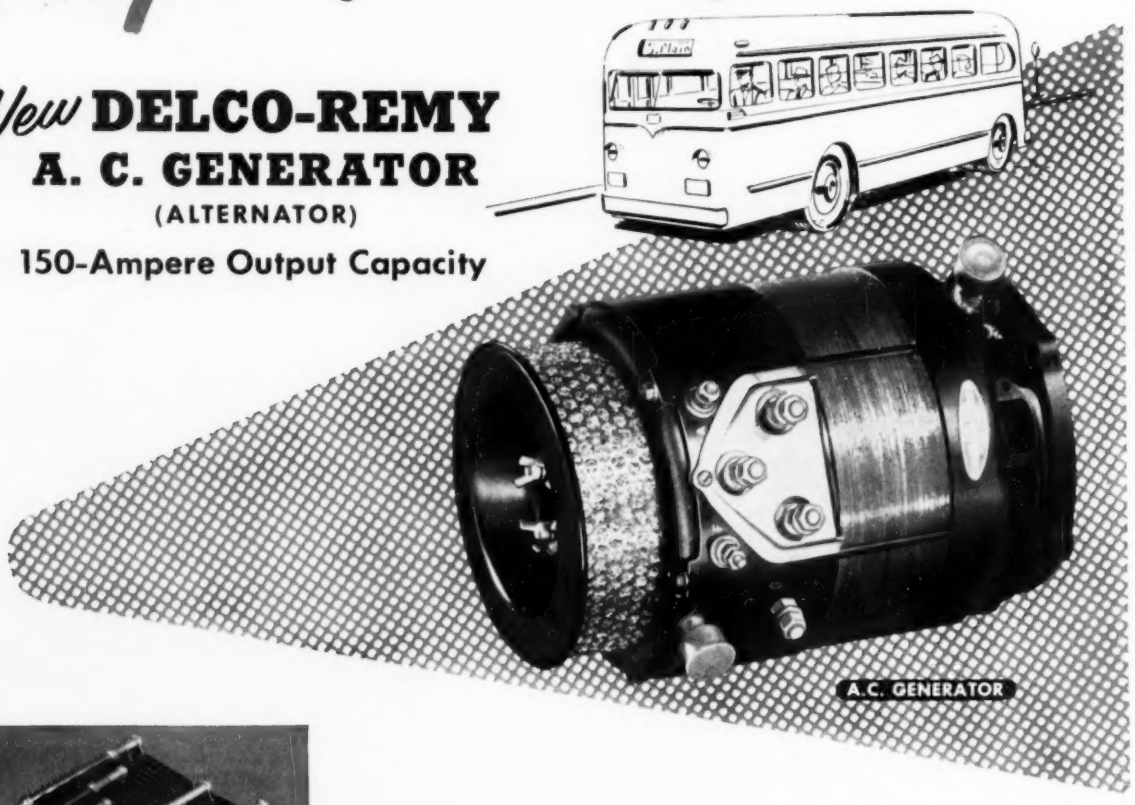
**Guided Missiles Division**
Wyandanch, L. I., N. Y.

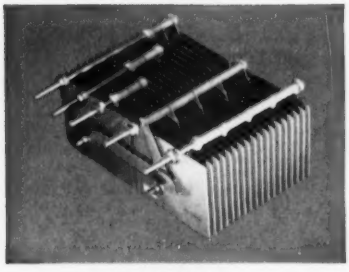
*More and more POWER developments for America's Armed Forces*

# *Right for the Job!*

## *New* DELCO-REMY A. C. GENERATOR (ALTERNATOR)

**150-Ampere Output Capacity**



RECTIFIER

REGULATOR

The new Delco-Remy A.C. generator is the heart of a 12-volt A.C.-D.C. electrical system designed specifically for modern Diesel buses with fluorescent lighting and extra-heavy electrical loads.

It cuts in at approximately 550 generator rpm and reaches a maximum output of 150 amperes at approximately 1175 rpm.

The new generator not only supplies alternating current for fluorescent lighting, but also ample direct current for the heaviest electrical loads coupled with lengthy engine-at-idle periods.

Impressive features of the new generator are its relatively light weight, its very high output capacity and its ability to operate over a wide range of speeds.

Specify Delco-Remy electrical equipment on your new buses.

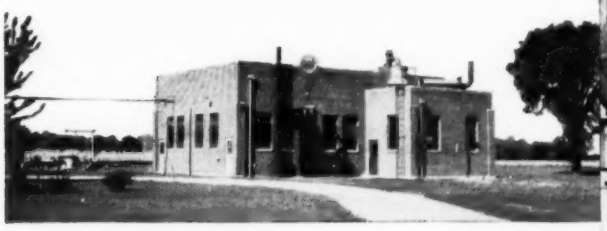
**DELCO-REMY**

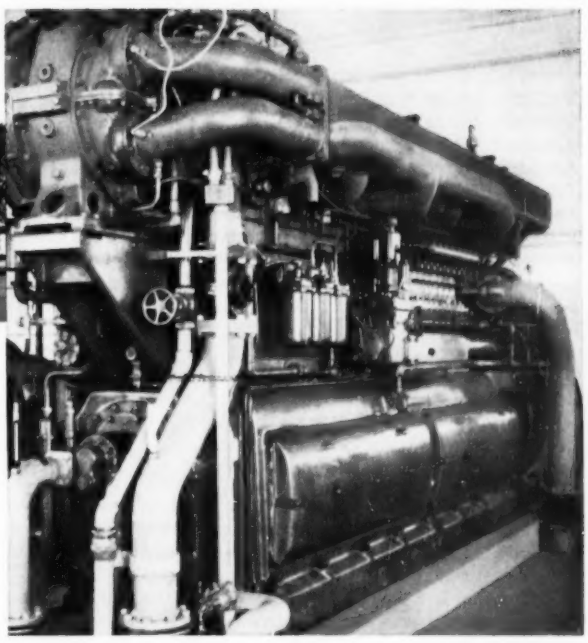
Division, General Motors Corporation, Anderson, Indiana

**WHEREVER WHEELS TURN OR PROPELLERS SPIN**

# 165,000 hours of service completed by 28 Alco Diesels at 98½% availability

## for Gulf Refining Company





Twenty-two years ago, Gulf Refining Company installed 28 Alco Diesel Engines on its new, 700-mile Tulsa-to-Spencerville Junction pipeline. Today, those 28 Alco Diesels have completed more than 165,000 hours of service and are operating at 98½% availability. And since 1941, when the output of the line was greatly increased, they have been in actual service an average of 97% of the time.

Pumping station superintendents throughout the United States and Canada specify Alco Standardized Diesels because of this kind of *proved* dependability——and because of these economy features:

- **Compactness**—for lower construction costs
- **Higher Engine Efficiency**—for lower fuel costs
- **Medium Speed**—for lower auxiliary equipment costs
- **Flexible Power Range**—for lower expansion costs

For the complete story on Alco Diesel Engines, contact your nearest American Locomotive Company Sales Office. You will find them in New York, Beaumont, Chicago, Cleveland, Houston, Kansas City, San Francisco, Schenectady and St. Louis.

**ALCO DIESELS**

THE MARK OF MODERN ENGINEERING

AMERICAN LOCOMOTIVE COMPANY

# THE ENGINEER'S REPORT

DATA

LUBRICANT RPM Delo Oils

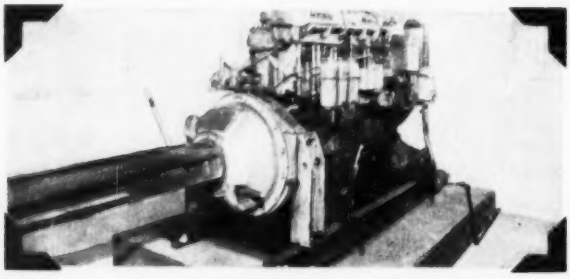
UNIT Caterpillar D13000 diesel

CONDITIONS Constant load

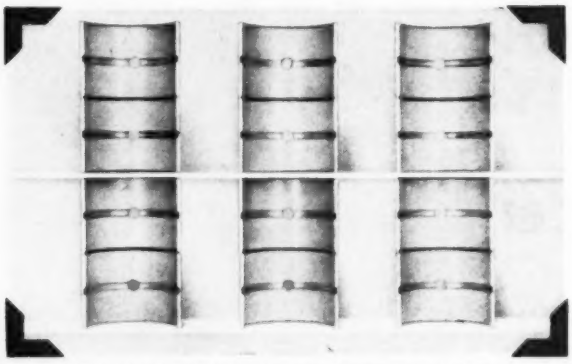
PERIOD 7650 hours

FIRM Dean H. Thayer, Mesa, Ariz.

## Only 0.001″ bearing wear in 7650 hours of work!



WORKING UNDER A CONSTANT LOAD pumping water, this D13000 diesel on the Dean H. Thayer ranch, Mesa, Arizona, ran 7650 hours before it was overhauled. An emergency made it necessary to run the engine for several days without safety cut-offs. Severe over-heating caused the governor to stick and the unattended engine reached a speed of approx. 1800 r.p.m. before it could be shut down.

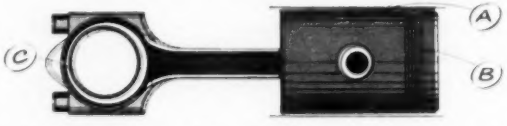


OPERATED ON RPM DELO Supercharged-2 Lubricating Oil during the 7650 hours, con rod bearings showed only 0.001" greatest wear. There was no pitting and all parts were unusually clean.

NO MEASURABLE WEAR was evident on the pistons which showed original tool marks. Greatest wear on liners was 0.005. Piston rings were all free, oil rings were open. After inspection, main bearings, crankshaft, cam & cam bearings, piston pins and bushings were all put back in service.

REMARKS: This engine operates year 'round in widely varying temperatures. In wintertime, the irrigation water is used to prevent the crops from freezing.

### How RPM DELO Oils keep engines clean and prevent wear




A. Contain special additives that provide metal-adhesion qualities...keep oil on parts whether they are hot or cold, running or idle.

B. Anti-oxidant resists deterioration of oil and formation of lacquer...prevents ring-sticking. Detergent keeps parts clean, helps prevent scuffing.

C. Special compounds stop corrosion of any bearing metal, and oil foaming in both wet and dry sump engines.

There is an RPM DELO Oil to meet every heavy-duty engine operation condition. FREE BOOKLET on the RPM DELO Oils gives you complete information. Write or ask for it today.

RPM DELO LUBRICATING OILS

TRADEMARKS "RPM DELO" REG. U.S. PAT. OFF.

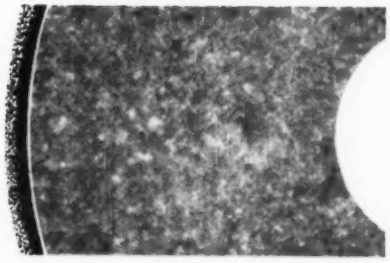
FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

STANDARD OIL COMPANY OF CALIFORNIA • San Francisco 20
THE CALIFORNIA OIL COMPANY • Barber, New Jersey
STANDARD OIL COMPANY OF TEXAS • El Paso
THE CALIFORNIA COMPANY • Denver 1, Colorado

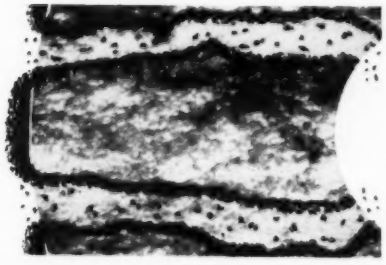
# GRADUATED DENSITY

## makes MICRO-KLEAN the most effective filter on the market!

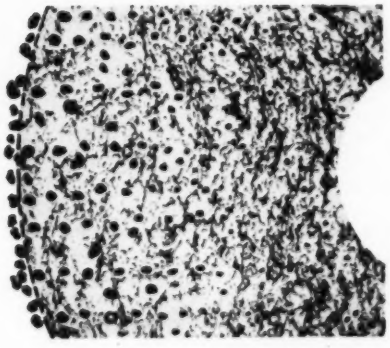
***How MICRO-KLEAN compares with other cartridge filters***



**Compare MICRO-KLEAN with FILTERS WITH THE SAME DENSITY THROUGHOUT.** The filter media density is the same on the pressure and discharge surfaces of the element; therefore, dirt accumulation is largely on the outside surface, choking the cartridge ("plastering") and reducing the effective filter life.



**Compare MICRO-KLEAN with FILTERS WITH HAPHAZARD DISTRIBUTION OF FILTER MEDIA.** Uneven haphazard media density permits fluid to find channels through the filter, and pass solids larger than the minimum filter spacing.



**Now Look at the advantages offered by MICRO-KLEAN.** See how the fibre density increases toward the discharge side of the MICRO-KLEAN filter cartridge? In effect, every Cuno MICRO-KLEAN cartridge is an infinite multiplicity of screens, ranging from relatively coarse on the outside down to 10 microns in the center. Because of MICRO-KLEAN's graduated density in depth, particles are entrapped within the entire depth of the filter element, giving the cartridge a much longer effective life. Standard cartridge size is 9¾" long by 2¼" O. D., in densities of 10, 25 and 50 microns.

**MICRO-KLEAN gives you**

- **greater dirt holding capacity**
- **absolute protection against rupturing or channeling of the cartridge**
- **longer effective cartridge life**

***REMEMBER . . . IF YOU CAN PUMP IT, CUNO CAN FILTER IT***

M.3.C

CUNO **ENGINEERED FILTRATION**
**Removes More Sizes of Solids From More Kinds of Fluids**

**AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)**

# MICRO-KLEAN FILTER HALVES CARTRIDGE REPLACEMENT COSTS

### Fewer Cartridge Changes Necessary with MICRO-KLEAN Filter

MICRO-KLEAN's graduated density-in-depth allows greater capacity for dirt accumulation within the micronic cartridge, giving you twice the life of an ordinary filter cartridge on fuel oil service. Thus cartridge replacement costs are cut in half.

The high porosity and low pressure drop operation of MICRO-KLEAN filters permit full-flow service on gravity, low pressure, or suction lines—with no loss in operating efficiency.

Each fibre of the MICRO-KLEAN filter is bonded in position by resin impregnation and polymerization. This provides great structural strength and complete protection against channeling, rupturing, shrinking and distortion.

Cuno's exclusive method of felting fibres produces a cartridge entirely unaffected by moisture, acids, or other damaging agents encountered in service. The MICRO-KLEAN cartridge will never soften and discharge contaminants into the injectors—or swell up and shut off flow.

Simplicity of installation and maintenance is assured by MICRO-KLEAN's specially engineered construction. Changing cartridges can be accomplished in a few seconds—only one nut has to be removed.

Take advantage of Cuno's unique "money-back" offer: if MICRO-KLEAN doesn't outperform any filter cartridge you have previously used, we'll send you *double* your money back. Send the coupon today for free MICRO-KLEAN bulletin.

M.3.2

Cuno Engineering Corporation
Dept. 23-CC South Vine Street, Meriden, Conn.

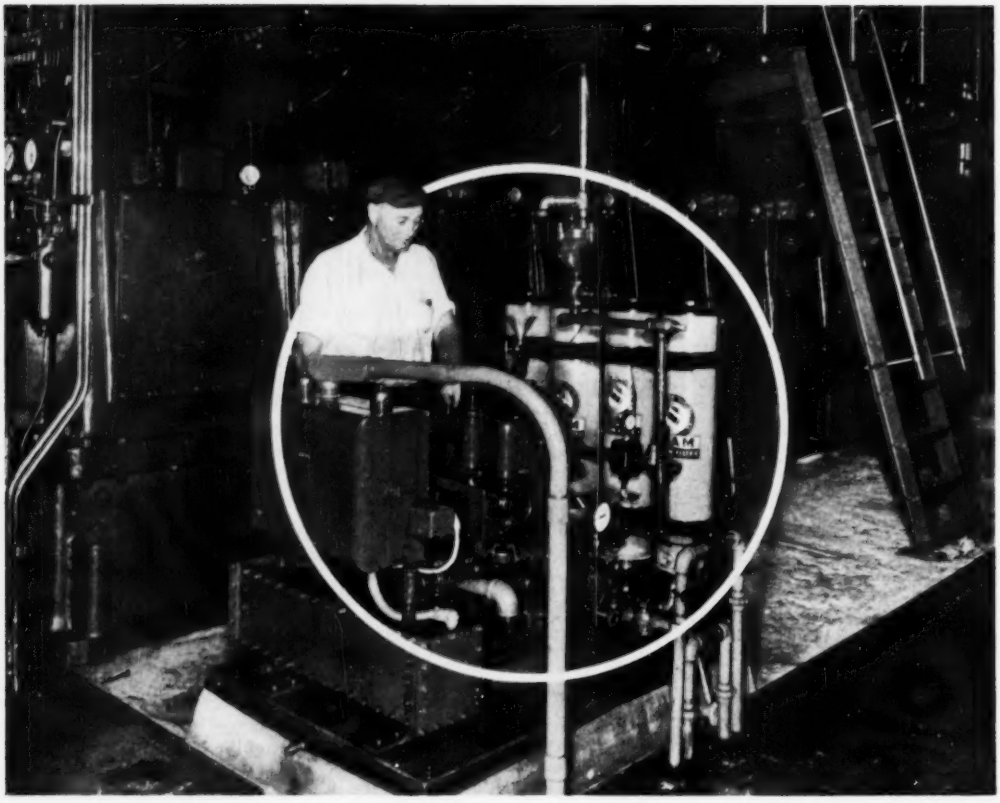
I'm interested in your "money-back" offer. Please send me bulletin on Cuno MICRO-KLEAN for Diesel engine protection.

Name . . . . . .

Company . . . . . .

Address . . . . . .

City . . . . . Zone . . . State . . . . . .



# REMOVE DIRT AND WATER AND CARBON, TOO WITH THE DE LAVAL "PURI-FILTER"®

The De Laval "Puri-Filter" removes ***all three*** major contaminants of diesel lubricating oil: dirt, water and colloidal carbon. The first two are separated from the oil by centrifugal force in the bowl of the De Laval Oil Purifier—the water being discharged continuously. The colloidal carbon is then filtered out of the purified oil.

The De Laval "Puri-Filter" combines the De Laval "Uni-Matic"® Oil Purifier and Fram "Filcron" filters. Because the combination unit gets rid of all contaminants down to one micron in size, and also keeps the oil completely free of moisture, it is the most effective means ever devised for protecting diesel engine bearings.

● Write for additional details on the De Laval "Puri-Filter" for diesel lubricating oil. Ask for Bulletin DL-1.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6

DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

**DE LAVAL OIL PURIFIERS**

***FOR DIESEL LUBRICATING OIL***

# P&H Diesel Engines

**(2-CYCLE)**

## *Can your diesels match this torque curve?*

This is the torque curve for the P&H Model 687-C Diesel Engine. Note how the torque characteristics are sustained throughout its entire horsepower range.

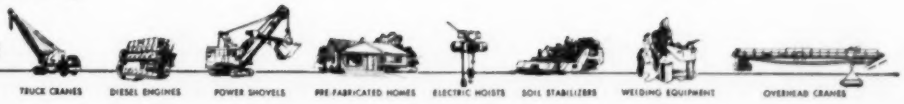
That means steady, responsive power at all speeds — greater lugging "ability" for those toughest jobs. It's the kind of unfaltering performance that assures more profits in any service, constant or intermittent.

Steady torque for steady work is just another outstanding feature of P&H Diesel Engines — America's most advanced line. Ask your P&H Diesel representative for the full story. Or write for literature.

P&H Diesel Engines are built in 1, 2, 3, 4 and 6-cylinder models — up to 145 h.p.

**P&H DIESEL DIVISION**
**HARNISCHFEGER CORPORATION**
**CRYSTAL LAKE, ILLINOIS**

*the* P&H *Line*



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February, 1953

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Cover Photo: Earthmoving equipment carries away mountains of earth from vessel slip site at U. S. Steel's new Fairless Works to make room for vessels bringing in ore from Venezuela.

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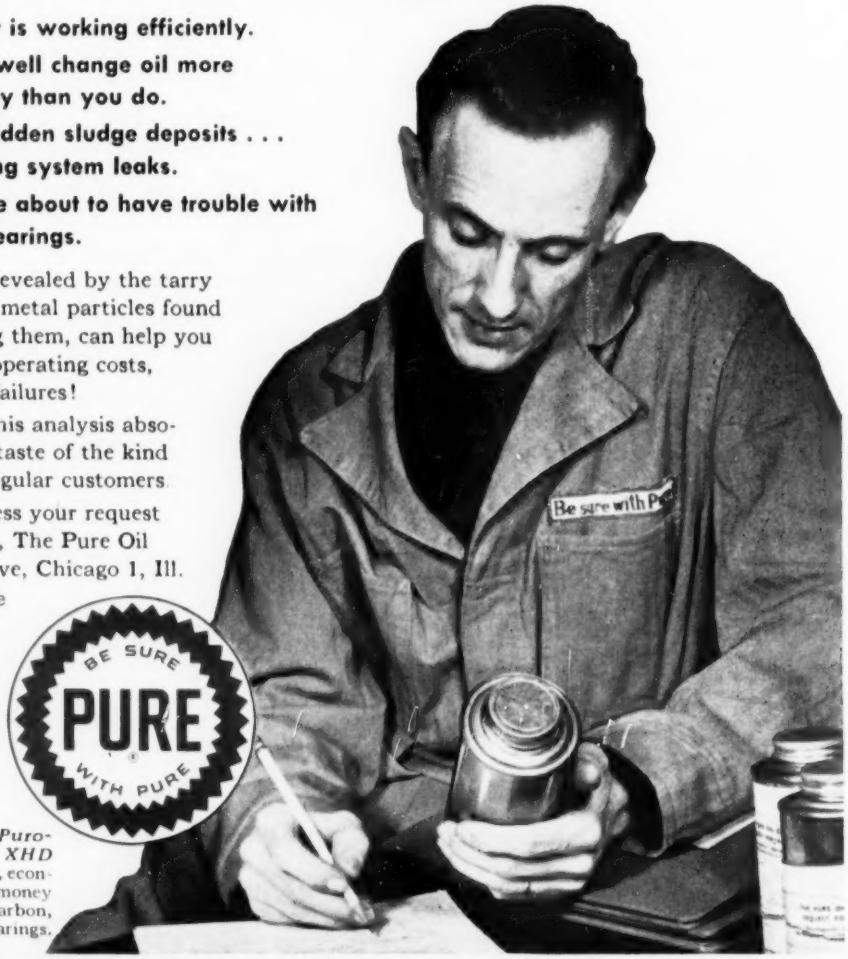


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## *Editorially Speaking . . . .*

# You Can't Halt Progress!

Canada is booming. Dieselization of the railroads is no exception. Messrs. J. D. Sylvester, Canadian National Railways, and D. F. Haney, Canadian Pacific, addressing a symposium on land transportation at the Winter General Meeting, American Institute of Electrical Engineers, presented some interesting facts.

Diesel-electrics have increased from 5 to 605 units in 10 years on Canada's two largest railroads. Canadian National and Canadian Pacific with 40,000 miles of rail spanning the continent, have a total of 4390 steam and diesel locomotives compared with 3982 in 1942.

It is notable that the increased use of diesels has not resulted in a corresponding decrease in the use of steam locomotives. Our speakers say that this is indicative of the expanding economy and population increase in Canada. Apparently expansion will be met with diesels, replacement coming as a later phase.

Canada leads in this hemisphere by putting a diesel passenger unit in service on the Canadian National in 1928. The program then lagged, largely through lack of Canadian fuel oil, until the opening of the Alberta oil fields in 1947. Then the program spurted ahead.

Today, total horsepower is 728,750 compared to 4710 a decade ago. The two railways have accumulated 96 million miles, over one-half in switching service and the remainder in road service since 1948. This has been accomplished under conditions involving rugged terrain and extremely cold climates.

This is progress. It means increased revenues, lower costs and a generally sounder financial structure.

Now, word comes to us that representatives of independent coal operators in Nova Scotia and the District 26, United Mine Workers of America, are engaged in a program to fight the Canadian National's proposal to put 10 diesel locomotives on the Moncton-Mulgrave run. They claim — and probably rightly so — that the loss of this coal market will hurt a number of people. As individuals they have our sympathy.

However, transportation and distribution are high up on the list of factors effecting today's economies. Penalize transportation, and you penalize everything and everybody. Historically, countries have progressed or have been retarded almost in direct proportion to the status of their transportational system.

Historically, it is also impossible to block progress. Suppose that an Association of Wood Splitters and Charcoal Burners had succeeded in preventing the use of coal. There would have been no jobs in the coal industry. Or suppose that the Buggy Whip, Oat Suppliers and Blacksmiths Federation had halted the progress of the automobile. Literally millions of our workers would not have their present jobs, to say nothing of the profound effect it would have had on our way of life.

The point is: Progress makes jobs. We've proven that throughout the history of our country. Perhaps a fight about 10 locomotives appears to be a small thing. So is an acorn; but look what happens.

There seems to be a growing tendency for a desire to "protect" this and to "guarantee" that. This must be fought at every turn. When this sort of thing gets out of hand it is tagged "socialism". We'll vote for the homely philosophy that business, whether run by government as in this case, or as free enterprise as in our country, should be free to conduct that business in what they consider to be the most efficient manner.

"Make-work" pressures and artificial stumbling blocks (we have them, too) will only interfere with real progress to the detriment of all.

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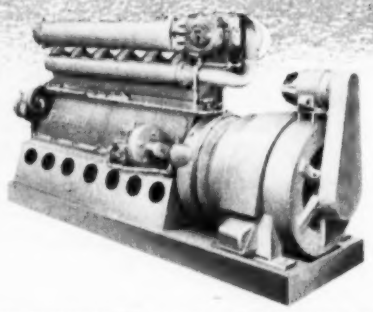
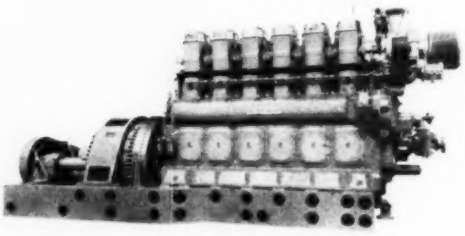


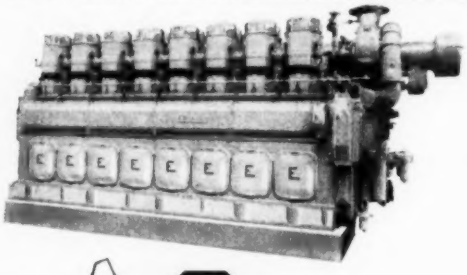
**MODEL DSM-36**

Enterprise M Series Diesels are built in 3, 4 and 6 cylinder models, 8" bore x 10" stroke. Turbocharging is available on 6 cylinder engine, as shown at left. Ratings in this series range from 68-400 HP at 450-800 RPM.

**MODEL DSG-36**

Series G Diesels, in 6 and 8 cylinders, furnish slow speed, heavy-duty power in a wide variety of services. Designed with 12" bore x 15" stroke, this series is rated 273-1388 HP at 250-600 RPM. Turbocharging available on all models.





**MODEL DSQ-38**

Largest in the Enterprise line, Series Q Diesels are built in 6 and 8 cylinder models, 16" bore x 20" stroke, normally aspirated and turbocharged. Conservatively rated 647-2056 HP at 250-375 RPM.

When you buy Enterprise, you can count on prompt, expert service. Enterprise branch offices and parts warehouses are strategically located to provide 24-hour service to every point in the nation.

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# + HIGHLIGHTS +

● E. S. Pettyjohn, director of the Institute of Gas Technology, an affiliate of Illinois Institute of Technology, recently announced the offering of 15 fellowships for graduate students preparing for careers in the gas industry.

● The Union Pacific Railroad has ordered 25 gas turbine locomotives from GE. These will be used principally for freight service.

● New York, New Haven and Hartford recently placed an order for 30 Budd diesel rail cars. Also, two diesel tugs costing about $450,000 will be launched in the near future.

● In the first 11 mo of 1952, Class I railroads installed 2840 diesel power units in service. Locomotives on order as of December 1, consisted of 748 diesels made up of 865 units, 19 gas turbine, 17 steam, and 10 electric.

● American Trucking Associations, Inc., have announced that, based on U. S. Bureau of Public Roads' figures, it will require an annual expenditure of $1,846,000,000 for ten years just to make our main interstate highway system adequate for today's traffic.

● Canadian Pacific's 292 diesel locomotives chalked up almost 18 million mi during 1952 as compared with the 61,000 mi traveled by the first five diesels back in 1943. CPR has 73 additional diesels on order.

● During 1952, about $55½ billion were spent in moving persons and goods in the United States by all methods, according to ARBA treasurer, J. Randolphs.

● In a paper presented at the Winter General Meeting of the AIEE, L. G. Carpenter of GE, cited the importance of adequate grounding of equipment that might come in contact with electric current. In 1951, 177 injuries, including one death, resulted from contact with ungrounded equipment in California.—Safety First.

● George Mann, Jr., general manager of GM's AC Spark Plug Div., recently predicted an intensively active year for the automotive parts and accessory business in 1953.

● With more steam locomotives being scrapped every day, Norfolk and Western is still sticking to coal.

● General Motors Diesel Ltd., of London, Ontario, recently delivered the first three of nine diesel-electric locomotives scheduled for general railway service in Newfoundland.

● Low water conditions in the South and Pacific Northwest are still curtailing primary aluminum production. Nothing like having a few diesels for standby service!

● It is predicted by Chester H. Lang, GE vice president, that by 1961 the expanding production of American industry will call upon the transportation industry to handle a 29 per cent greater load than it is currently handling.

● Alcoa recently predicted primary aluminum production in the U. S. should be approximately 100 tons greater than 1951, water shortage and all. Alcoa's Point Comfort works added 35,000 tons to production. Point Comfort is powered by diesel and gas engines.

● Wilbur S. Mount, of Socony-Vacuum Oil Co., in a recent address at the SAE annual meeting in Detroit, stated that "raising the average mileage for passenger cars in the United States just one mpg would mean a saving of 1,800,000,000 gal of gasoline a year."

● ATA recently announced that the 1953 National Truck Roadeo will be held at the Minnesota State Fairgrounds in the twin cities of Minneapolis-St. Paul, from September 15 to 19. The event is designed to give national recognition to the best and safest drivers in the nation.

● Want to know more about "Automotive Antifreezes"? Then drop a line to the U. S. Government Printing Office, Washington 25, D. C. for a copy of National Bureau of Standards' Circular 506, cost—15 cents.

● FPC has authorized the Kansas-Nebraska Natural Gas Company, Inc., to install four 500-hp units in its Holcomb, Kansas compressor station instead of one 2000-hp unit.

● Budd recently announced that demand for their diesel rail car is increasing. At present, 38 of these self-propelled units are on order for various railroads.

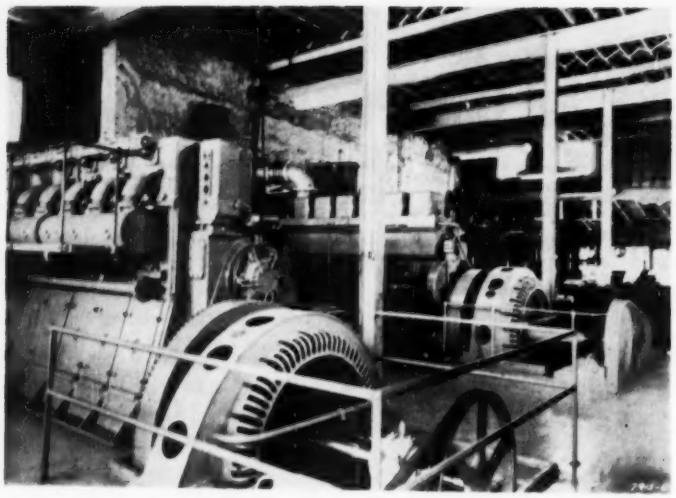
● Standby engine-generator sets are becoming more numerous every day. Another of these has recently been installed by Caterpillar for the Central New York Broadcasting Corp. of Syracuse.

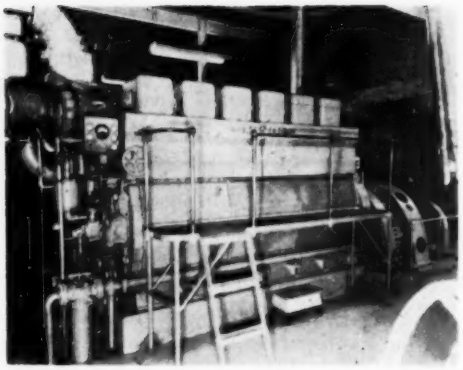
● "Care Will Save Your Car" trade meetings sponsored by automotive jobbers associations throughout the country are increasing in popularity. Perhaps a similar occurrence might be possible in the diesel field.

● New York's double-decker buses which for a number of years have dotted the city's landscape are fast disappearing. They are being replaced with the standard type—diesel-powered of course.

● Engineers of the Westinghouse Electric Corporation recently unveiled a gas turbine locomotive with wheels that not only turn on curves, but also move from side to side under the cab for smoother riding.

● According to Steelways, chances of finding a medium field of oil capable of supplying the nation for a week are only one in 330. Wildcat drillers may invest up to $1000 a day to drill a well that has only one chance in 991 of hitting a field large enough to supply the country for more than seven days.





*Operating side of Duafuel engine that changed plant's operational pattern and effected substantial savings.*

*At left, operating floor with (l to r) a Busch-Sulzer, new Nordberg and in background, two air-injection Busch-Sulzer engines.*

# New Engine Carries 71% of Output

*By Leonard Whitted*

*Superintendent, Light and Power Dept., Baldwin, Kansas*

**Fifth engine, a 900-hp Nordberg Duafuel unit, operating both as dual-fuel unit and oil engine, carries bulk of load while cutting fuel cost $6452 in first full year.**

Adding another engine to a plant does not mean simply more horsepower and hence kilowatts. It can change the entire pattern of operation and have a tremendous effect on over-all operating costs.

For example, installation of a 900-hp Nordberg Duafuel engine in our Baldwin, Kansas municipal plant in the fall of 1950 resulted in a reduction of 34 per cent in total plant fuel costs in the first full year of operation. The new unit, our fifth, generated 71 per cent of total plant output.

This progressive Kansas community of 1300 population, home of Baker University, oldest 4-year college in the state, has had long experience with internal combustion prime movers in its municipal utility. The city first provided electric power for its citizens in 1906, utilizing a spark-ignition natural gas engine. In 1917, the first of the units still in service was installed. This was a 165-hp, 4-cycle Busch-Sulzer air-injection diesel. Five years later, a 180-hp diesel of the same type was added. In 1938, the city purchased a 250-hp Busch-Sulzer, again an air-injection engine.

In common with other similar communities, Baldwin experienced sharp and rapid growth in the electrical demand in the years following World War II. Increase in the popularity of electric stoves and other appliances boosted the residential consumption which constitutes the major part of the load. There was more commercial lighting and air conditioning and more activity in such local industries as the creamery and woodworking factory.

To meet the growing demand, Baldwin installed, in 1946, a 6-cyl mechanical injection Busch-Sulzer diesel rated 540 hp at 360 rpm. But load development continued at so rapid a rate that soon firm power was again below requirements and it was impossible to carry the load without the newest engine. Recognizing the need for plant expansion to provide adequate reserve power to insure unfailing service, it was decided to purchase a unit large enough to carry the existing peak load with some margin for load growth. At the same time, it was logical to take advantage of modern dual-fuel design and utilize the available supply of cheap natural gas.

The engine chosen was a 4-cycle, supercharged Nordberg Duafuel, with six cylinders of 13-in bore and 16½-in stroke, rated 900 hp at 450 rpm. This engine went into regular service in the fall of 1950 and promptly assumed its position as the plant's top prime mover in both production and economy. In the 12-month period from November 1950 through October 1951, the engine was in operation 5205 hr and produced 1,559,800 kwh, over 71 per cent of the plant's total generation.

Flexibility and economy in fuel consumption of the new engine are major advantages that we fully utilized in the Baldwin plant. Most of the time, the engine runs on natural gas with a small quantity of diesel pilot oil, but when gas pressure drops, the engine switches instantly to fuel oil.

## Some Results

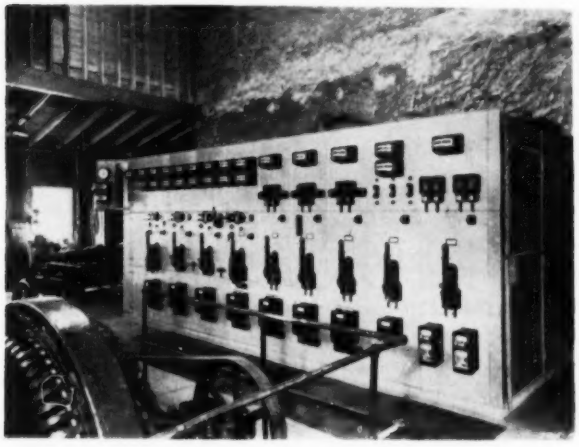
In the year (August 1949 through July 1950) before we had the new dual-fuel engine, the plant produced 1,965,100 kwh on 171,910 gal of fuel oil. At the city's current price of 10 cents a gal, this meant a fuel cost of 8.70 mills per kwh. With the dual-fuel unit in service for a full year, the total plant's fuel consumption was 95,886 gal of oil at a cost of $9588.60, and 17,054 mcf of natural gas costing $2924.11. With production at 2,179,859 kwh, this meant that the total plant's cost per kwh dropped to 5.74 mills.

Compared with the previous cost of 8.7 mills, this represented a saving of 2.96 mills per kwh, a total of $6452.38 for the year.

The Nordberg engine, operating mostly on the dual-fuel principle but part of the time on oil, produced its 1,559,800 kwh on 41,012 gal of oil and 17,054 mcf of gas at an average fuel cost of 4.49 mills per kwh. A typical month such as October 1951, when the unit ran wholly as a dual-fuel engine, shows what economies can be achieved. In this month, with engine production at 132,500 kwh on 977 gal of oil and 1810 mcf of gas, the costs per kwh were:

| | |
|---|---|
| *Natural gas* | *2.70 mills* |
| *Pilot oil* | *0.73 mills* |
| *Total fuel* | *3.43 mills* |

As yet, load conditions do not permit operation of this unit at peak efficiency. Peak load reaches 550 kw on winter evenings, a good load for the engine. But on winter nights, the load drops as low as 120 kw. Usually one of the smaller engines is used to carry the valley load, but it has been found profitable to run the newest engine even at relatively inefficient load levels. Thus the average operating engine load factor, at which the cost figures above were cited, was no better than 50 per cent.



*New generator was tied in to existing switchboard.*

PRINCIPAL EQUIPMENT—DUAFUEL ENGINE

| | |
|---|---|
| Engine | Nordberg Manufacturing Co. |
| Generator | General Electric Co. |
| Governor | Woodward Governor Co. |
| **Fuel System** | |
| Oil meter | Neptune Meter Co. |
| Gas | Cities Service Gas Co. |
| Gas meter | American Meter Co. |
| Gas regulator | Pittsburgh Equitable Meter Co. (Emco) |
| **Lube Oil System** | |
| Oil | Standard Oil Co. (Indiana) (Standard HD) |
| Filter | The Hilliard Corp. (Hilco Hyflow) |
| Cooler | Ross Heater Div., Kewanee-Ross Corp. |
| **Cooling System** | |
| Jacket and raw water pumps | Deming Mueller |
| Cooling tower | Marley Co. |
| Air filter | Air-Maze Corp. |
| Snubber | Burgess-Manning Co. |
| Pyrometer | Illinois Testing Laboratories Inc. (Alnor) |

*Plant modernization also included new front facing city's main street.*

## Other Operating and Plant Details

Lubricating oil consumption on the dual-fuel engine has been extremely low. A detergent oil is circulated through the engine under pressure by a built-in pump and this circuit includes a shell-and-tube oil cooler. Whenever the engine is in operation, a small motor-driven pump draws lubricating oil from the crankcase, puts it through a cellulose-type filter and returns it to the crankcase. Filter elements were changed for the first time after 10 months and at that time, the oil was in good condition and the crankcase was as clean as new.

The entire plant is served by a single closed cooling water system. A pair of motor-driven centrifugal pumps circulate soft water through the engine jackets and through the coils of an induced draft cooling tower. A thermostatic valve on the engine maintains the desired temperature by by-passing water around the tower. Two motor-driven centrifugal pumps provide raw water for the tower sprays. For make-up in the jacket system, we use city water treated in a zeolite softener.

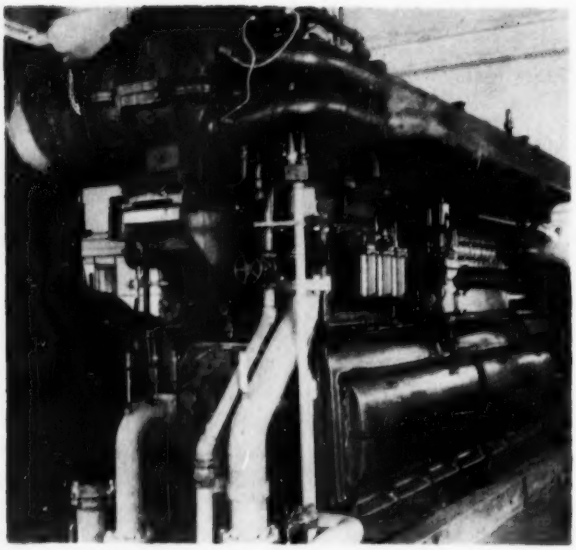
The Nordberg engine is arranged for convenient operation with an exhaust pyrometer and pressure and temperature gauges mounted on the operating end of the unit. In addition, safety devices protect the engine. An alarm sounds if water temperature goes too high or lube oil pressure drops too low. If lube or pilot oil pressure fails, the gas is cut off automatically. If gas pressure fails, the engine switches to fuel oil.

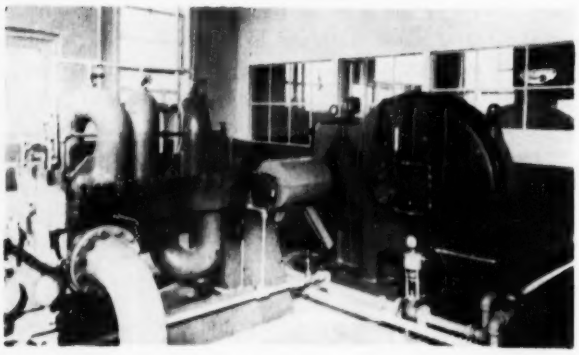
## Conclusion

Installation of this modern engine raised the total plant horsepower by about 53 per cent and yet the unit, because of its flexibility and economy, has been used to produce over 71 per cent of the plant's total output. Substantial savings in fuel costs have resulted.

Baldwin is a small town about an hour's drive from either Kansas City or Topeka. Those exercising policy supervision of the plant are Mayor C. V. Reeves, and the Council Committee on Light and Water which includes Chairman Merlin G. Ford, Earl T. Black, and George L. Rhine.

Baldwin's attractiveness to residents (many commuters to the bigger cities) and to local businesses includes excellent educational facilities, good rail, bus and truck transportation and, high on the list, dependable utilities. We feel that now, the city can count on unfailing electric light and power and look forward to greater municipal profits through lower power costs.

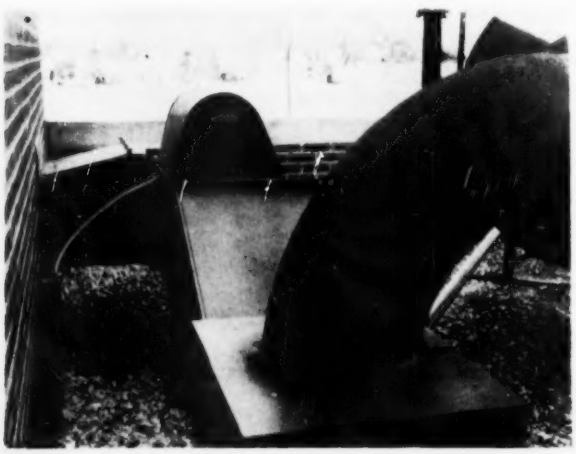




*Top. View down side of new Alco diesel. Starting from the turbocharger in foreground, fuel filters, governor, and fuel injection pumps are seen.*

*Six-stage centrifugal pump driven by diesel through step-up gearing at 4550 rpm. Note bearing lubrication system with automatic temperature control.*

*Below. Combination heating and cooling system for station. Blower draws warm air from exhaust line jacket or by louvre reversal, cooling and ventilating air.*



# More Pipeline Power for Greater Throughput

**New pumping unit, most powerful on Gulf's Tulsa-Lima Pipeline, is designed to raise output of station 46 per cent and increase differential pressure 400 psi. Crude oil from pipeline is used for fuel.**

IT'S no secret that petroleum product demands are on the increase. This means more crude oil delivery to refineries. Where pipeline deliveries are involved, you either put in a bigger pipe or you push it through faster. Naturally the latter is more practical, up to permissible pressure limits. This takes plenty of power and good dependable power too, because it is a day-in and day-out type of service.

Recently, the Gulf Refining Company was faced with the situation arising from this growth pattern and solved it, not only for the present, but with an eye to the future. Let's see how the solution worked out in practice.

## Some Background

This 700-mi pipe line was built originally in 1930 to transport crude oil from Tulsa to refineries at Cincinnati, Toledo, and Pittsburgh. Northern terminus of the 10-in line is Spencerville Junction (10 mi southwest of Lima, Ohio) where it joins the Buckeye line. Originally, there were 14 pumping stations, 13 with a total of 28 Alco diesels rated 316 hp, and one station with three 200-hp De La Vergnes. All engines drive reciprocating pumps. In 1936, line capacity was increased by installing one 340-hp Busch-Sulzer diesel at each station.

Performance record of the original engines is worth noting. During the first 11 years of operation, from 1930 to 1941, the engines operated an average of 75 per cent of the time. Since 1941, all the engines have run an average of 97 per cent of the time. Thus, the original Alco diesels have run more than 164,000 hr in the 22 years.

Today, these stations continue their heavy operating schedule without standby equipment. While in actual service an average of 97 per cent of the time, each engine is available for service 98½ percent of the time and shut down for maintenance only 1½ per cent.

In 1941, the line met the demand for greater throughput by increasing speed and output of all existing engines, getting an estimated 360 hp from the 316-hp units, and raising line pressure from 700 to 800 psi. Deliveries to

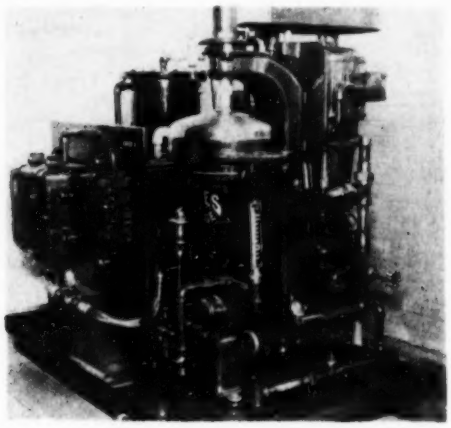
Lima were further increased by construction of a new station at State Line on the Indiana-Ohio border, 38 mi south of the Junction point with the Buckeye line.

This station went into service in February 1942, with a 425-hp Cooper-Bessemer diesel driving a 3-stage Goulds centrifugal pump. Volume was 41,000 bbl per day with a pressure differential of 500 psi. Finally in 1950, it became necessary to increase deliveries to Lima by another 6000 bbl per day.

## Planning Expansion

Rather than adopt some makeshift to provide for immediate needs, Gulf engineers decided on a major expansion of this key station. The idea was not merely to deliver the 47,000 bbl per day then required, but to allow for anticipated future production of 60,000 bbl at a suction pressure of 100 psi and a discharge of 1000 psi.

To accomplish this, the company installed the line's most powerful engine, a 1170-hp diesel. This latest prime mover, like the original engines of the line, is an Alco diesel of the 4-cycle McIntosh & Seymour design. It is an 8-cyl unit with 12½-in bore and 13-in stroke, developing rated horsepower at 650 rpm.



Driving through a gear unit of 5.409 to 1 ratio, the diesel turns a 6-stage United Iron Works centrifugal pump at 3550 rpm. The pump is rated at 1750 gpm at 2660-ft head. Engine and pump currently are handling an average of 47,000 bbl per day, but have the capacity to pump 60,000 bbl at a pressure differential of 900 lb when pipeline capacity is increased to handle that volume.

State Line Station operates as a booster station in a closed system, receiving oil from Dublin Station, 40 mi to the south, and pushing it along to Spencerville Junction and Lima to the north. To insure that the powerful pumping unit does not pump the incoming line dry, automatic valves actuated by incoming oil pressure throttle pump output.

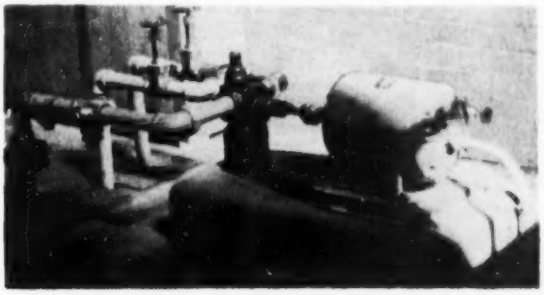
In the installation of the new diesel and accessory equipment, Gulf engineers exhibited painstaking care and considerable ingenuity.

## Crude Oil for Fuel

Crude oil is taken from the pipe line and stored in a 1200-bbl tank. Operators try to load up the tank with good fuel but take whatever is available when necessary. The crude is transferred from storage to a 250-gal day tank by an automatic float-controlled gear pump.

The oil is heated to 110°F by heat transfer from engine jacket water and then it put through a centrifuge, after which it is pumped to a 250-gal clean-oil tank. The clean-oil tank has an overflow line back to the dirty-oil tank so that it is possible to keep the centrifuge running for 5 or 6 hr, running the oil through several times.

From the clean-oil tank, the fuel flows by gravity through a cellulose filter to the engine's booster pump which delivers the oil through another filter to the individual fuel injection pumps. Surplus from the pumps returns through a spring-loaded relief valve to the clean-oil tank.



*Crude oil for fuel is cleaned in this Sharples centrifuge unit before final filtration.*

*A simple pump and piping arrangement permits lube transfer to and from any part of system*

## Lube Oil System

The Alco is lubricated with Gulf *Dieselmotive B*, a detergent-type oil circulated through the engine under pressure by an engine-driven pump. Included in the circuit is a shell-and-tube oil cooler utilizing engine jacket water to cool the oil. An automatic thermostatic valve bypasses oil around the cooler as necessary to maintain the desired temperature. Some oil is piped from the pressure side of the engine circulating pump to a duplex waste-packed filter.

Lube handling is simplified by a highly flexible arrangement of piping. Drums of oil are emptied into a 500-gal tank and thereafter are handled entirely by a motor-driven transfer pump. Lube can be pumped to or from the engine crankcase, lube cooler, discharge line, bypass line, and sump tank. Thus, if the oil became contaminated, it would be possible quickly to empty the entire system and replace the dirty oil with a full charge of clean lube. Engine down-time would be held to a minimum.

To afford the engine maximum protection and keep wear and maintenance down, the lube is kept in peak condition.

*Gulf's State Line Station housing the new engine. Air cleaner, exhaust silencer, and the cooling and ventilating system are atop building extension. Pipe line and manifolding are behind building.*

The oil is tested on regular schedule to check on acid, solids, and viscosity.

## Cooling System

Engine cooling water is circulated through the closed cooling system by a centrifugal pump, driven off the engine. Water at 147°F is pumped through the diesel's jackets, leaving the engine at 160°F. Some of this hot water is used to heat the fuel oil, some in a unit heater to heat the plant office.

The jacket water is cooled by the incoming crude oil of the main line in a shell-and-tube heat exchanger with 1645 sq ft of cooling surface. Cool water from the exchanger is used to cool pump bearings, mechanical seals, gear unit lube, and engine lube.

## Other Systems

Waste heat from the exhaust gases is used to heat the plant and the arrangement is flexible and convenient. The hot gases pass through a jacketed line to the horizontal silencer on the roof. A motor-driven blower draws warm air from the jacket and discharges it into the engine room in cold weather. Louvres in the discharge section of the blower can be reversed in hot weather so that the blower vents to the atmosphere and serves to cool and ventilate the plant.

Intake air for the engine is drawn through an oil-bath filter on the roof to the exhaust-driven turbocharger on the diesel.

A gauge and alarm panel holds a multi-point exhaust pyrometer; pressure gauges on lube, water and fuel; and alarms on low lube pressure and high or low jacket water temperature. Starting air for the diesel is provided by a motor-driven compressor. The plant has a 17.5 kw diesel-generator set to provide electric power to run the motor-driven auxiliary equipment and to supply emergency lighting if outside power sources are cut off.

Gulf's biggest diesel is operating the heavy schedule required of all prime movers on the line, averaging 97 per cent running time and even greater availability.

## *What Do You Know!*

**More questions concerning different phases of the diesel field. Make your selections, then turn to Page 89 for the correct answers.**

1. Some modern spark-ignition gas engines can be converted to diesel or dual-fuel operation by relatively minor external changes involving adding injection equipment, manifold changes, control changes,

   a. True  b. False

2. The effective compression ratio of an engine can be changed by which of the following methods?

   a. Reducing combustion space in the cylinder head
   b. Varying the timing of the inlet valve
   c. Changing piston design (distance from pin to crown)

3. To give service in power plants, the state of maintenance is an important consideration. All phases of maintenance should preferably be handled in the shop and full tooling provided without regard for other considerations.

   a. True  b. False

4. Purpose of the energy cell in the Ianova combustion system is to perform which two of the following:

   a. Provide a zone of higher temperature and pressure
   b. Promote turbulence and control combustion
   c. Produce higher cylinder pressures

5. The minimum volume of air chemically required to burn completely a typical commercial fuel oil is about——times the volume of the oil itself. Select one of the following as being approximately correct.

   a. 7000  c. 9000
   b. 8000  d. 10,000

6. For a normally aspirated engine a convenient rule of thumb for full-load fuel requirement is—mm per cu in of displacement. Select one of the following.

   a. 1 mm  c. 2 mm
   b. 1½ mm  d. 2½ mm

7. Considering nozzle orifices of the same size, whether they are well-rounded and smooth or sharp-edged will affect principally which two of the following characteristics?

   a. Penetration  c. Atomization
   b. Volume delivered  d. Pressure

8. With an existing pipe line, which of the following is the most practical solution to get greater through-put?

   a. Can't be done  c. Increase pumping pressure
   b. Build another line  d. Speed up flow

9. "Differential pressure" in pipe line service is considered to be the difference between:

   a. Absolute and pump outlet pressure
   b. Atmospheric and pump outlet pressure
   c. Pressure at pump suction and pump outlet pressure

10. Diesels are safe in poorly ventilated areas because of low carbon monoxide content in the exhaust. Which of the following combustion by products is a good odiferous indicator of approaching toxic conditions?

    a. Water vapor  c. Carbon
    b. Aldehydes  d. Oxides of nitrogen

*Fig. 1—Checking and rebuilding of fuel injection equipment is done on this specially equipped bench with precision tools, a job for highly skilled personnel.*

**Here are some of the things the Erie road is doing to boost diesel locomotive availability.**

# Erie's Maintenance Program

By Walter Rudolph

AS dieselization progressed, Erie studied its program to find where the greatest rather than the quickest returns could be realized. For preventive maintenance pays off on the long pull. Such studies have brought about longer sustained runs between overhauls; extensive pooling operation between different types of diesel power; steam operation cutdown; and capitalization on the inherent versatility of the road switcher.

The program has boosted locomotive availability to a high percentage. This points to good management and well planned maintenance as the following table indicates.

| | Passenger | 4-Unit Freight | Road Switcher | Yard Switcher |
|---|---|---|---|---|
| Percent available | 87.8 | 84.3 | 93.7 | 93.9 |
| Fuel oil gal per hr | | | | 5.9 |
| Fuel oil gal per mi | 2.058 | 7.0 | 2.28 | |
| Lube oil gal per mi | .019 | .085 | 0.020 | .073 |

Erie calls it "progressive maintenance"—the same thing Benjamin Franklin was thinking about when he said, "A stitch in time saves nine"—preventive maintenance. On this road, diesels are maintained continuously at the same point and a surplus of stored horsepower is never required, as was the case with steam power where a third unit backed up every two in service. This progressive maintenance also makes great use of exchange components: one can be removed and serviced while a

Fig. 2

Fig. 3

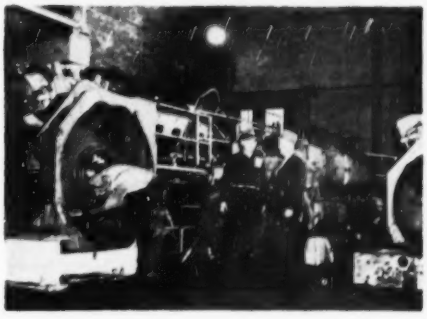


Fig. 4

*Fig. 2—In another part of the injection shop a rebuilt (top) nozzle is being checked for spray pattern and popping pressure. It will be noted that protective container and cover which trap fuel spray have been removed for photographic purposes.*

*Fig. 3—Test is being run on a single-unit fuel injection pump of the Bosch APF type. Pump discharge is fed into a cylindrical graduate for check on output rate.*

*Fig. 4—Alco and EMD diesels are shown in various stages of repair. Looking on are: master mechanic, Harry Phelps and A. R. Strawser, general foreman (right).*

duplicate is installed and the locomotive returned to service.

This procedure results in one of Erie's principal economies from diesel—higher availability. For example, only a relatively short time is required for a truck, traction motor, engine, or generator to be removed and another put in its place. When components are removed, they go through established, efficient servicing channels, which lead back to the stock room to await another locomotive and complete the cycle. Locomotives are returned to service as soon as replacement parts are installed, thus maintaining a high percentage of availability. Road locomotives are maintained between such change-outs on a mileage basis, while switchers are regulated by service time.

## Records and Inspections

Naturally, records play a large part in any efficient maintenance program. In addition to daily yard checks, switchers are inspected on a monthly, quarterly, semi-annual, and annual basis. Road freight units are inspected every 3000 mi, the inspection lasting about 5 hr. In connection with this, maintenance shops are required to keep records indicating mileage for units in their charge. Items checked at 3000-mi intervals are also noted on a master check list.

When a unit has accumulated 100,000 mi, it is run into the shop for more extensive inspection and maintenance than the 3000-mi check. At this time regular ICC inspections are made. At 500,000-mi intervals, the diesel unit gets a 4-day rest while the engine, main generator, and air compressor are removed and overhauled replacement units installed. After the locomotive is fully reassembled, it is tested under load and returned to service if tests prove satisfactory. Road passenger units follow a similar cycle except that they encompass twice the mileage; freight units work harder, comparatively.

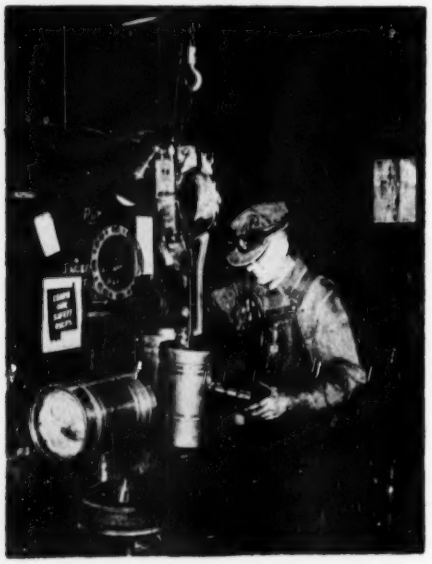


*Fig. 5—Here, one of Erie's mechanics reassembles an Alco piston and connecting rod. In the foreground an EMD water pump awaits work.*

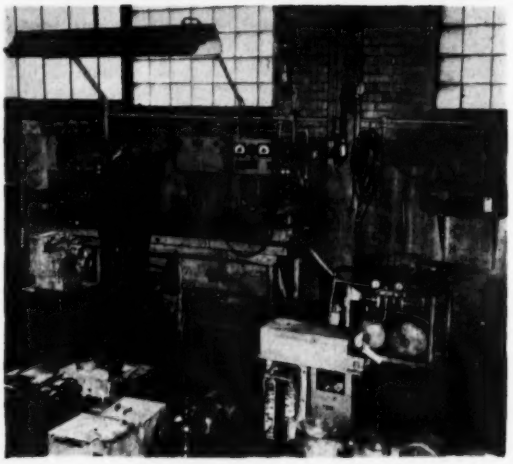


*Fig. 6—Erie has fabricated many jigs and stands such as those shown here for two types of cylinder head.*

*Fig. 7—Engine governors get a thorough inspection and running test at this bench in the electrical shop. Test panel indicates all circuits for testing.*

Progressive maintenance and records are carefully coordinated. This enables maintaining personnel to practice preventive measures, which further prolong the diesel's long life. A record is also kept on component parts of the locomotive, aiding to compute the longevity of such items.

Maintenance in any particular part of a diesel shop can be balanced by the entire maintenance system. Records indicate the amount of service to be expected from different components so that a unit can be shopped before a road failure occurs. All this aids to log the study of mileage cycles, pertaining to maintenance, and helps to indicate necessary change-outs.

Another feature incorporated in the program is the concentration of units of similar make at different points in the trunk line. This reduces the number of replacement parts required in any one inventory, increases the efficiency of mechanics on that particular type of engine, and aids overall evaluation of the types of power.

## Fuel and Lube Handling

Fuel oil storage capacity on the Erie is distributed to 33 different points and totals almost 4,000,000 gal. Tanks vary, from 20,000- to 1,000,000-gal capacity, with pro-

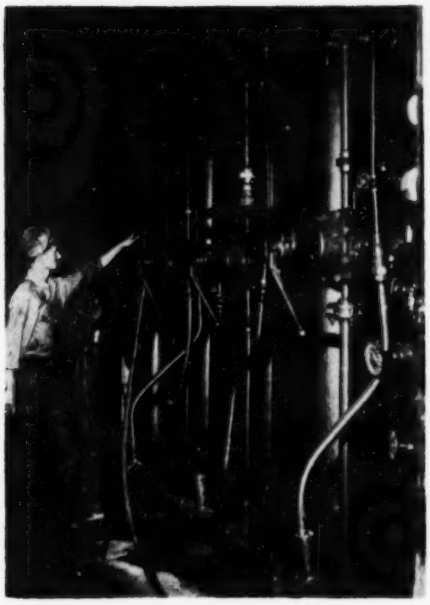


*Fig. 8—Cooling systems, steam generators, and boilers require less attention and give longer service between overhauls if water is demineralized, or softened. Here a check is being made of twin sets of Dearborne chemical water treatment units, that give water with less than ½-grain of undissolved solids.*

Test personnel wire any special handling reports to maintaining terminals. Erie's largest shop terminals at Marion, Ohio, and Hornell, New York, have test department representatives. Bad engine conditions reflected in oil samples are commuted to master mechanics so that defective functioning is remedied before engine failure.

When oil dilution reaches 5 per cent, oil is changed and is processed for rejuvenation and storage. Each shop has a 75-gal batch oil reclaiming plant. During a running maintenance interval, oil is removed from freight or passenger engine and passed directly into this plant. Reclaiming work returns almost original physical properties to the liquid. The Marion shop, for example, uses the same type of additive originally used by the oil refiner to refortify used oil.

## Water Too

Water hardness is another factor seriously considered by Erie in diesel maintenance. Naturally, in the 1,000-mi run from Jersey City to Chicago, hardness varies from as much as 1.0 grain per gal to 50 grains per gal. This condition, and scale formation in steam generators, is combatted by location of demineralizing plants along the line for advantageous water stops.

Scale troubles are also minimized through incorporation of diesel steam generator type chemicals and booster pumps at emergency water supply points, and by using chromate type water treating compounds for diesel engine cooling systems. Tests are made every trip on through freight and passenger engines, and weekly on switch engines.

*Fig. 9—Diesel lube oil is pumped from the locomotives into this batch reclaiming room at the Marion shop. The original additive used by the refiner is used to refortify reclaimed oil.*

*Fig. 10—Filters of all kinds, removed from diesels at maintenance intervals are sent to this room for cleaning. Special tanks were constructed to do the job on a production basis.*

vision for fire prevention and protective measures at all storage points. New ways of receiving, storing, and feeding fuel oil to locomotives are constantly being studied to increase efficiency and safety.

Lubricating oils are of the heavy-duty detergent type, the culmination of a gradual shift from straight mineral oils, to additive type oil, down through the dieselization program. Periodical examination of oil used in all types of locomotives and switchers is the core of the scientific lubrication study and maintenance system. Samples come from switch engines once a month, road freights at 10,000 mi, and road passenger engines every 20,000 mi.

Tests of these samples include those for dilution, ash content, viscosity change, blotter spot and water content.

## Summary

Much is being done to improve preventive maintenance procedures in a great many shops, Erie being only one of these. However, there still remains a large number who just don't bother until a failure occurs. The preventive maintenance theory should be inculcated from the top man down.

Artist's conception of the Fairless Works upon completion.

# Diesels at U. S. Steel's Fairless Works

**Diesel power is used in this modern plant, styled the "Mill of Tomorrow", and at the ore source in Venezuela for rail switching movements, locomotive-type cranes, and tractors.**

Illustrated above is one of the switching locomotives for the Fairless Works. Note the duel-level couplers and one-sided cab.

Operating a steel plant of this size is a man-size job. Rail operations alone require a fleet of diesel-electric locomotives. Facilities for servicing and maintaining the diesel equipment comprises a large part of the plant's 40-acre maintenance center.

This large maintenance center will provide all necessary maintenance services for the entire, fully integrated steel plant which is located on a 3939-acre tract at Morrisville, Pa. Apart from the diesel shops, a building approximately 772-ft long, 292-ft wide, and 65-ft high, houses: central store, oil storage, fire house, and a substation for distributing light, heat and power to the maintenance area. But before we go into the diesel shops, let's take a look at the overall picture.

Groundbreaking ceremonies were held on March 1, 1951, and in December, 1952 production of steel was started. In that short space of time, a large percentage of some 9,500,000 cu yd of earth was moved and 800,000 cu yd of concrete poured. Ore for the plant is, at present, being shipped from the upper Mesabi range; but eventually, ore from Venezuela will move by water direct to the plant. Shipments from the Venezuelan ore mines are scheduled to begin in 1954, but there are still many uncertainties which could delay this phase.

## Diesel and Car Repair Shop

A building with basically the same construction as that used for other maintenance houses the diesel shop. It consists of a structural steel frame with windowless corrugated steel sandwich walls and an insulated truss-supported composition roof. Sliding panels in the walls and a continuous ridge ventilator in the roof provide ventilation.

In addition to normal ventilation, mechanical ventilation is provided in parts of the shop with a separate system to remove diesel exhaust gases. Heat is supplied through large floor-mounted space heaters. These heaters are supplied with steam from the plant's steam distribution system.

Lighting facilities were designed after a careful study of light intensity requirements for various work areas. In this building which has a high roof, a high bay lighting system with dual units and reflectors have been installed. Dual units consist of an incandescent light together with a mercury vapor lamp, so as to duplicate natural light conditions as closely as possible, since the building is windowless.

The diesel shop comprises several shops designed with facilities sufficient to service and maintain a fleet of one 600-hp and 18 1200-hp diesel-electric switchers (Baldwin-Lima-Hamilton and Fairbanks, Morse), as well as one 50-ton and four 40-ton capacity diesel-electric powered locomotive-type cranes.

This shop has auxiliary reconditioning shops for cleaning, machining, and repairing small parts. There is also a wheel shop for necessary machine work on wheels and axles and for required hydraulic press work in removing and replacing wheels on all rolling equipment.

The car repair shop is contained in this building for repairs to all types of rolling stock used in a steel plant. In addition, the building provides space to house the maintenance crews and equipment which will keep in condition the 75-mi of railroad track in Fairless Works, as well as space for shops for repairing various kinds of power trucks, tractors and bulldozers.

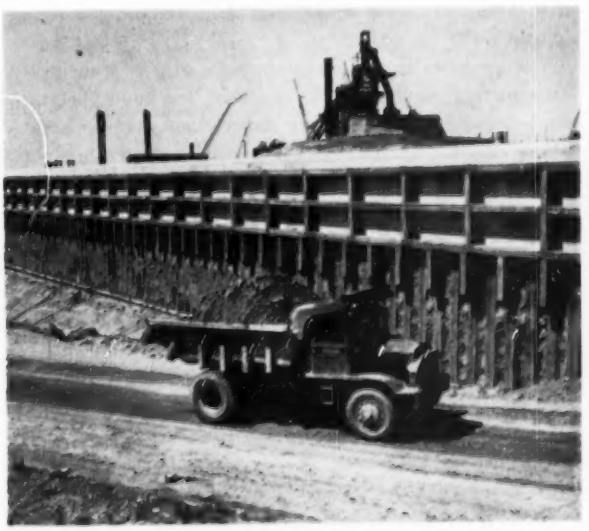
SANDING AND FUELING FACILITIES—A specially designed sanding station to handle wet and dry sand for diesel locomotives was installed near the diesel shop. In addition, a diesel fueling station for locomotives and a gasoline and diesel fuel oil station for trucks and other vehicles were installed in this area. Further details as to these facilities, their operation, the work to be done and manner of handling are not yet available.

## Diesel Power Helps Get Ore Out

It is interesting in this connection to know that in Venezuela, at Cerro Bolivar ore mine, electric power will be generated by two 2500-kw units, driven by diesel engines. After ore is blasted from mountain, it will be loaded into 90-long ton capacity railroad cars by three large shovels, two of which will be driven by electric power and one by diesel.

Ore will travel 40 mi by rail from Cerro Bolivar to Puerto Ordaz, where it will be loaded into boats for water movement direct to Fairless Works. Ore will be handled in trains of 125-cars each, hauled by 3-unit (1600-hp per unit) diesel-electric locomotives. Since the grades to port will be predominantly downhill, the limiting factor for the size of these loaded trains will be braking capacity of locomotive and train. Evidently these locomotives will utilize dynamic braking to good advantage. On the return trip the limiting factor will be the power to haul empty cars up grades as high as 3 per cent. Maintenance shops for this railroad will be at Puerto Ardaz.

During construction—Lima dragline and fleet of euclids were used in construction vessel slip where ore carriers will tie up. Dock wall is shown in picture at right.



Large diesel-powered dump trucks carried away mountains of earth to make room for more than 239 million gal of water to float ocean-going vessels bringing ore in from Venezuela.

Injection equipment is serviced in this clean, well-lighted shop.

# Tools and Equipment

By John Keen*

**What tooling? What equipment? How far should I go? Some answers to these questions and some ideas contributing to plant efficiency are discussed.**

WE aren't selling kilowatt hours; we're selling service. Kilowatt hours are secondary. People we serve aren't worrying too much about how many kwh they consume, but when they turn on a switch they want something to happen. Primarily, they want continuity of service —service 24 hours per day, 365 days per year.

None of us can afford to have extra units lying around idle waiting for a breakdown; we have to work to closer tolerances than that. The fact is that many of us running power plants do not even have firm power today. In other words, during certain times of the year if the plants lost their largest unit they would have nothing to replace it with to carry them over the peaks. This places a premium on good operation.

Energy costs to the consumer must also be considered. This further emphasizes the necessity for good operation, so fortunately this objective serves two main purposes. Many articles have been devoted to telling operators ways and means of doing the main job of keeping the engines running economically and efficiently. I plan to skirt the fringes and touch on some of the items that might be termed the secondary line of defense backing up the primary objective.

Here, I would like to say that the ideas that I am passing on are based on our operation. Before considering adopting any of them, several factors should be weighed. Size of the plant is a consideration; ours is relatively large. The availability of suitable facilities in your vicinity for having certain jobs done must be determined before any investment is practical. Also, the availability of certain skills in your plant must be taken into account.

## Tooling is Important

Having the proper tools available does not only save time and effort but helps to get a better job done. I will not attempt to list the specific tools that are supplied with each engine because they will vary somewhat according to the design of the particular unit. Rather, I would like to discuss some of the larger and specialized tools found in the machine shop or in the well-equipped tool room. MACHINE SHOP—I believe all will agree that an arbor press is very essential. Adjacent should be a pedestal-type drill press. Sizes and capacities will, of course, be determined by local considerations. Over in the corner, shielded to prevent sparks contacting other equipment, you should have a medium-sized arc welder. This welder should be portable so that it can be moved to any plant site for pipe welding, etc. Next to the welder is a good location for your gas welding and cutting equipment.

Under the shop windows would be a good spot for your lathe. Of course, there are types and sizes that will fit in most machine shops with capacities to suit the particular engines that you may have. It is my suggestion that the size and elaborateness of the lathe be determined by the anticipated work and the personnel available to operate it. If you are fortunate enough to have a skilled machinist in your organization, it might be to your advantage to purchase a lathe more elaborate than is normally found in generating plants and to increase the scope of your machining repairs.

These are the major tools required to handle the jobs that normally come up in the course of repairs. I have purposely neglected to mention small hand tools because I believe it is unnecessary to go into any detail, due to the fact that most plants are equipped with the proper

* *The author is Assistant Manager, Wolverine Electric Cooperative, Big Rapids, Mich. The article is based on his comments at an REA Generating Conference, Milwaukee, May 1952.*

# for Greater Plant Efficiency

bench grinders, electric drills, wrenches, workbenches with vises, etc.

TOOL ROOM—Most of the tools kept in the tool room will be fairly standard and will have been accumulated in the course of operations. Therefore, I will confine my discussion to a few that have proved particularly useful to us.

I am as much, or more, conscious of safety in carrying out our work as I am of any other phase. I believe, therefore, that it is essential that every diesel plant should be equipped with an impact wrench. Most plant men have faced the requirement of removing nuts from cylinder heads with a sturdy wrench and sledge hammer. If you have a 250-lb man in your organization, it might not be too difficult for him to remove some of them with an 18-lb sledge. We consider this impractical as well as dangerous from the point of safety of men and equipment. For these reasons, we insist that an impact wrench be used for this heavy work.

While on the subject of safety, there is another item that will help remove the hazard of tools scattered around on the floor, and be most helpful as well. It is a portable tool stand that can be wheeled into the tool room for loading and then wheeled out to the operating floor and the job location. This provides a convenient place for placing small parts during disassembly as well as making the tools readily available.

Another item that has proved very useful around the plant is a commercial-size vacuum cleaner of the tank type which can be used to pick up dirt and grease without harming the machine. Some people say that a compressed air hose is equally advantageous. I agree that it loosens the dirt, but it does not get rid of it. The vacuum cleaner captures the dirt, water, and grease, instead of just stirring it around.

We have found considerable use for another small portable item—a self-contained pumping unit. A small centrifugal pump, driven by an electric motor having a long extension cord, is assembled on a caster-mounted base. Lengths of garden hose are connected to the pump inlet and outlet. When it becomes necessary to clean out a sump tank or perform some such difficult operation, you will find such a pump very useful.

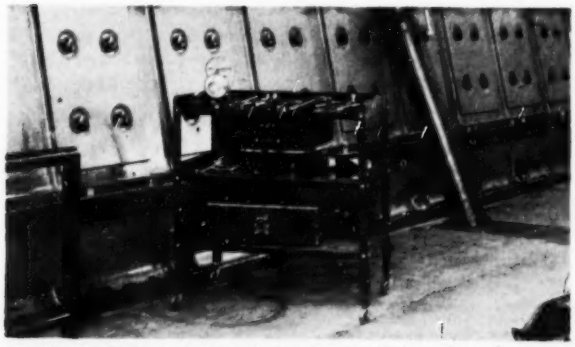
## Special Stands Help

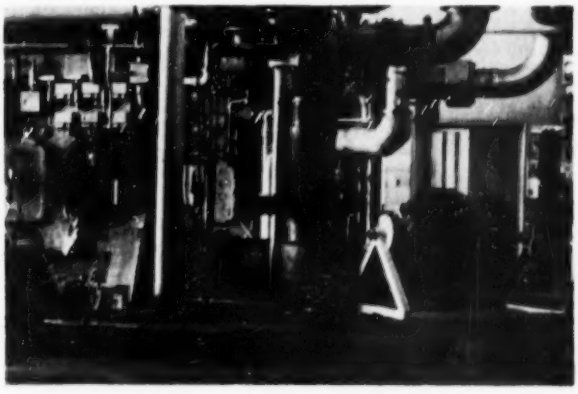
In individual plants, many ideas can be worked out in the form of stands and special fixtures, each simplifying some operation. An ideal example is a framework or stand for supporting a cylinder head during repair work.

One of our operators constructed such a stand for a total cost of $18. It can be rotated to facilitate reconditioning operation. This jig has saved us a good many hours of labor by enabling one man to completely dismantle the component parts. Valve cages can be removed, inspected, repaired if necessary, and reassembled in the head with a minimum of effort.

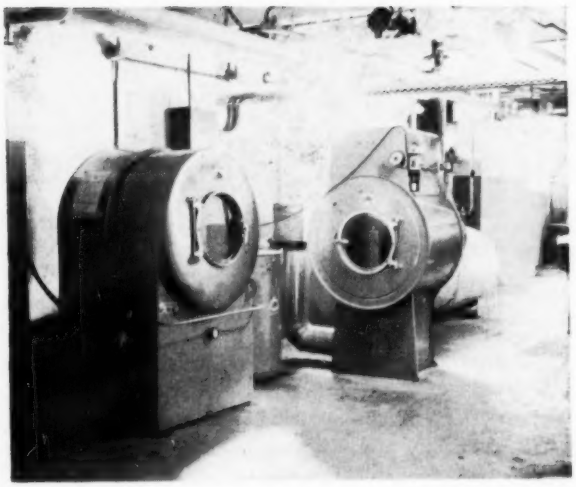
## Repairing Injection Equipment

We are all aware that at present-day fuel costs it is necessary that we keep our fuel pumps and spray nozzles in the best operating condition possible. If these get away from us a little bit, fuel costs rise rapidly. Therefore, if you have enough injection equipment and the properly skilled personnel for this type of work, it can be very





*A rolling table for tools (above) and special stands, such as the one at left, aid a great deal in maintenance work.*



*View of machine shop (above) shows lathe, drill press, arbor press and arc welder.*
*Laundering equipment (right) pays for itself in this type installation by cleaning wiping rags.*

advantageous to equip a special room for this repair.

This step must be carefully thought out. Amount of injection equipment is one factor. Proximity of a good injection equipment repair shop where you can get speedy repair service is another. The quality of the repairs is important. In some areas, if we had to depend on manufacturers' service we would need two or three complete sets of nozzles for each engine that we have. This would really run up our stock cost tremendously, let alone the repair cost.

Granted the proper conditions, such a repair shop is practical. We do not claim to have the best possible setup, but we feel that it is quite adequate. In addition to the usual nozzle pop testers and other tools, we have purchased a high- precision machine that is actually a centerless grinder. We can grind the faces of our needle valves, and cast iron seat laps when used, to a tolerance of 5 min at any angle from 45 to 65 deg. This covers all the spray valves with which I am familiar. In this way we get valve seating that will last for many thousands of hours of operation and give a high efficiency at all times.

## Lube Oil Evaluation

We feel that it is very important to have equipment for a practical evaluation of your lubricating oil so that if you are in doubt at any time about the condition of your oil you can clear up the doubt in a few minutes' time. It must be understood that continuity of testing and interpretation of results are important. Also, the limitations of such testing equipment must be thoroughly understood.

Of course, you might say, you can send your sample to the supplier and he will give you an analysis. So you go ahead and bottle up a couple of quarts or a gallon of oil and mail it or take it to him. Either way it takes time—several days, perhaps a week or longer—before you get your analysis back. If the oil is bad you probably know about it before this time because you have equipment failure.

By keeping tabs on the oil through scheduled testing, you have an indication of your oil condition at all times and get early warning of engine irregularities. The fact is that the equipment will often pay for itself on the savings in lube oil filtering alone.

You may be running your filter elements for a certain number of hours before a change or you may base it on pressure drop. The fact is, these may be arbitrary ways of determining filter life and it might well be possible to get greater filter element life by pinning changes to the condition of the oil. Living with your engines, checking the oil condition periodically, and noting the normal trends in the build-up of contamination will enable you to see when things are not normal and that it is time to do something about it.

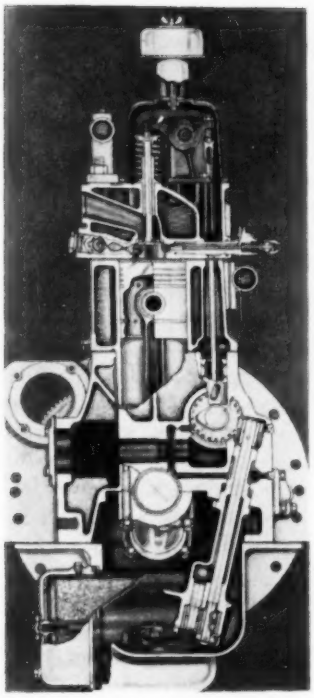
## Laundering Wiping Rags

Here is an example of how far it is possible to go in what might be considered an extraneous item of special equipment in order to provide convenience and in our case, to save money for the Cooperative. I emphasize again that such projects must be weighed very carefully with respect to cost, amount of use to be realized, savings expected, and the availability of personnel to operate the equipment.

The project concerns laundry equipment to clean up oily rags, etc. Perhaps you are in a locality where you can get rags or have your old ones laundered at reasonable cost, but in our area we find this service very expensive. In similar circumstances, consideration should be given to the practicality of a laundry installation. Incidentally, the fellows in the shops generally wash greasy coveralls, etc., in the same equipment, which no doubt makes their wives very happy.

We have four different generating plants located throughout the central part of Michigan. First, we thought of putting a small home-type laundry in each plant. These installations would cost about $500-$600 each, which seemed reasonable until we investigated further. We checked on the cost of a commercial-type plant. The cost for a unit of 25-lb dry material capacity was about $1800 and including a washing machine, extractor and dryer. It did not take long to figure that this would effect some small saving, but it did introduce the problem of trans-

(*Continued on page* 79)



# Minneapolis-Moline's Model "U" Diesel

**Farmers as well as industrial users of wheel-type tractors want more power and greater economy. Here is a recent addition to the growing list of diesel-powered wheel-type tractors.**

RECENTLY, the Minneapolis-Moline Company completed its first production lot of the new diesel-powered model U tractor. This model is in the 3- to 4-plow power class, developing 37 hp at the drawbar. The engine is an M-M product incorporating a specially designed and licensed Lanova combustion chamber and Bosch fuel injection equipment.

*Combustion System*—The main feature of this system—the reason M-M engineers have chosen it—is the use of an energy cell where rich mixtures of fuel are injected and burn rapidly. The rapid production of combustion gases builds up higher pressures and temperatures in the cell than in other parts of the combustion chamber, resulting in a high velocity jet stream being expelled into the main chamber. This jet produces very high turbulence to improve and control complete and progressive burning of fuel.

*Injection System*—As mentioned previously, the Bosch system has been adopted for this engine. The injection pump is the model PSB, single plunger type. Injection nozzles are designed for ease and economical servicing and replacement. The transfer pump is a gear type, insuring positive delivery of fuel to the injection pump.

*Fuel Filtration*—Clean fuel is an important factor in obtaining long engine life. With this in mind, M-M engineers adopted a 3-stage filtering system consisting of one primary and two secondary stages. The primary filter is a very fine screen, fine enough to separate some water from the fuel. A drain cock is provided to drain accumulated water from the system at the base of the primary filter. However, good operating practice demands the operator keep water out of the fuel storage container.

Secondary filters are made of micronic paper which has good properties for separating dirt from the fuel. The first secondary filter is placed before the transfer pump, and the final filter between the transfer pump and the injection pump.

*Lube Oil Filter*—A large capacity oil filter has been designed to fit into the engine oil sump. This arrangement is expected to improve filtering as oil temperature will be maintained closer to the desirable filtering range. It will be noted that with the filter located in the oil sump, it will not interfere with mounted implements.

*Pistons, Pins, Rings*—A heavy duty, cam ground, tin-plated aluminum piston with five piston ring grooves has been incorporated into the engine design. Three compression rings and two oil control rings are used with one oil ring above and one below the piston pin. Piston pins are full floating with liberal bearing areas and of the same basic design as those used in the M-M model 283 unit.

*Bearings*—High capacity bearings of Tri-Metal construction are used, Tri-Metal consisting of a steel shell and a section of copper alloy with a babbitt overlay. Due to the material used in crankshaft construction, it has been found that hardened journals were not necessary in developing a satisfactory design.

*Starting Equipment*—Early models produced used two 6-v batteries in series producing a 12-v system. However, 1953 production will have two 12-v batteries in parallel. Several cold weather starting devices are presently under test to determine which one is best suited to the engine to improve starting at low ambient temperatures.

Basically, chassis design is that of the gasoline-powered model U. However, changes were made to accommodate the battery, air cleaner and thermostat housings, and changes in the electrical system. The diesel engine is completely interchangeable with the gasoline engines used on other model U tractors. This allows conversion from gasoline to diesel with a minimum of effort.

# DIESEL BRIEFS

### *Multi-Drill Rig Cuts Time in Half*

Removal of strips of pavement to reach underlying utility lines has been greatly simplified by the R. L. Coolsaet Construction Co., of Dearborn, Mich., through use of a new arrangement of drilling equipment.

In this arrangement, six drills, 1 ft apart, are mounted on a small wheel-type tractor to which a portable air compressor is hitched. The equipment moves down the pavement as one unit, and according to the company, drills the necessary holes in half the time required by other methods. Holes 6 in apart are drilled by advancing the rig 6 in on one move, and 5½ ft on the next. A hydraulic hammer and backhoe follow and finish the job.

An Ingersoll-Rand rotary compressor, powered by a GM 2-cycle diesel, is used to supply air to the drills. Although the compressor's output is 600 cfm, it takes up little space in the street and is easily maneuvered.

### Brazil Orders 9 GM Diesels

Brazil's Vale do Rio Doce railroad has ordered nine diesel locomotives from the Electro-Motive division of General Motors Corp. Known as the Export Model B type, the units are suitable for both freight and passenger service and will be assembled at GM Diesel Ltd., Canada, with engines and electrical equipment manufactured in the U. S. Like the 40 units recently ordered by the Eastern Bengal railway in East Pakistan, carbodies will be of box-type construction and trucks will be meter-gauge.

### Cooper-Bessemer Forms Foreign Trade Subsidiaries

The formation of two wholly owned subsidiary companies was announced by Cooper-Bessemer Corp. to serve as exclusive export sales distributors for the companies engines and compressors.

Cooper-Bessemer International will handle all sales in the Western Hemisphere outside the United States. Cooper-Bessemer Overseas will be responsible for sales to the rest of the world. Both companies are headed by Michael C. Pollock in New York.

### Penn RR Now Largest Owner Of Diesel Power in U.S.A.

With recent delivery of the last road diesel locomotives in its current program, the Pennsylvania Railroad becomes the largest owner of diesel motive power, the railway announces.

Revealing receipt of the last four road locomotives in its $311,791,000 dieselization program, officials said the road now had 316 locomotives of this type in service, operating 2,553,770 hp. Fourteen diesel switchers were also delivered, bringing the number in service to 987, with 45 more to be received up to March. This will complete the current dieselization program with 1348 engines in operation.

### American Society for Metals Creates Research Foundation

Recognizing the grave shortage of engineering students in the United States, the 22,000 members of the American Society for Metals have voted to transfer an initial $650,000 for the establishment of a Foundation for Education and Research. This will provide an income of about $30,000 each year to be used for research and educational activities.

### Mack Exec Calls For Transportation Unity

A plea for transportation unity was recently voiced by James Donahue, vice president of Mack Motor Truck Corp. He pointed out that better coordination and cooperation among the different forms of transportation would strengthen the industry and benefit the public through better service and lower costs.

"If we can get together," Donahue said, "and make the public realize the importance of unhampered transportation, we can throw off many burdensome restrictions which, by hurting transportation, hurt the consumer." He stressed that the growth of the trucking industry in the last 30 years has not been at the expense of other forms of transportation but has meant more business for all.

# DIESEL BRIEFS

### Railways Use Trailer-Trucks To Speed Service in Canada

The Canadian Pacific Railway Company recently inaugurated Canada's first trailer-truck flat car freight transportation service, with cars leaving from Montreal for Toronto and from Toronto for Montreal. The operation is designed to speed service.

The trailers are loaded with goods at various points in the cities, and towed to the flat cars by tractors. Other tractors are attached at their destination and the goods delivered to consignees. The Canadian National Railways has announced it will operate a similar service.

### Industrial Waste Treatment

Use of synthetic ion exchange materials in industrial waste treatment was discussed at a recent meeting of the New York Sewage and Industrial Wastes Association by Mr. A. B. Mindler, special applications engineer of the Permutit Co., New York.

According to Mr. Mindler, one of the fields in which ion exchange holds most promise is the recovery of metals. Chromates, one of the most troublesome trade wastes can be recovered from plating and anodizing, he explained. At the same time, the purified wastes and the heat in the rinse waters are recovered for recycling. Savings in operating cost, installation cost, floor space, manpower and strategic materials are most striking.

### Reynolds Buys Bauxite Plant

Reynolds Metals Co. announced purchase of Berbice Co., Ltd., a British Guiana subsidiary of American Cyanamid Co., with a productive capacity of about 20,000 tons of bauxite a month. Included in the purchase were the plants, machinery and transportation equipment of the subsidiary, plus a stockpile of highgrade ore containing about 58½ per cent alumina.

Transfer of rights include three mining leases totaling 6254 acres, a 99-year lease on a 2040-acre plant site, and 482,210 acres with exclusive permission to explore and acquire additional mining leases.

### *From Show Horse to Work Horse*

Charred ruins made a dismal sight of the entrance to the Red Wing coal mine at Axial, Colo., following a fire which knocked out the mine's power plant. Prompt action was called for to restore the mine to operation.

A local Caterpillar distributor, the McCoy Co., was summoned and a D397 diesel-electric generating set originally scheduled as a showpiece at the American Mining Congress in Denver, was withdrawn from the exhibit and rushed to the mine.

Installation was begun immediately and emergency power was putting the mine back into operation a few hours after the unit arrived. The emergency unit, capable of delivering 315 kw, can be seen to the rear of the mine's burned-out power plant.

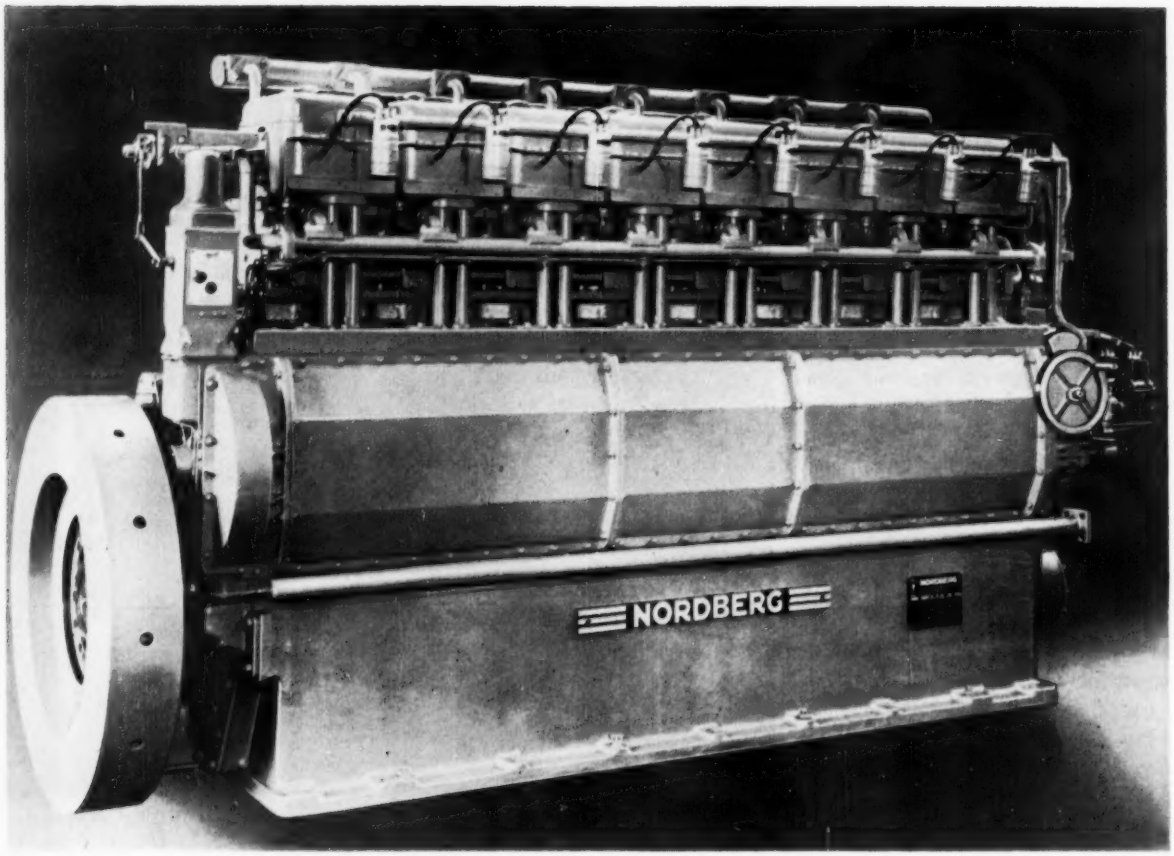
### Pakistan Railroaders To Train at EMD

The first of two teams from the Pakistan Railways are scheduled to arrive at the Electro-Motive Div. of General Motors in February to receive instruction in operation and maintenance of 40 diesel locomotive units recently purchased for their Eastern Bengal lines. The first five of the 40 units will be delivered this summer.

### UN Organizes Tour For Asian Railway Experts

Sixteen railway experts from Southeast Asia and The Far East are on a four-month round-the-world study trip, organized by the United Nations, to give them an opportunity to obtain first-hand knowledge of modern methods and equipment used in industrially developed countries.

The group will visit seven countries in Europe and tour the United States. The journey is linked with the establishment of a United Nations regional railway training center to come into existence this year.



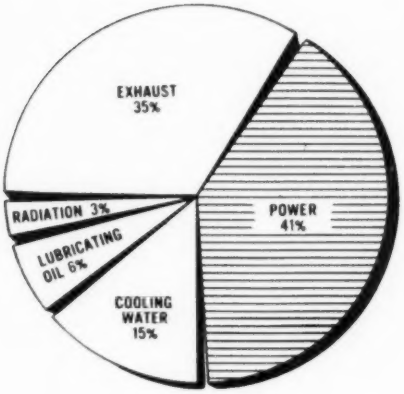

# Nordberg's "FSE" Engines

PRODUCTION of an efficient series of 4-cycle spark-fired gas engines was recently announced by Nordberg Manufacturing Company, Milwaukee 1, Wisconsin. These engines, known as Types FSE-9 and FSE-13, are built with 9-in and 13-in bore sizes respectively. Models are available in non-supercharged, supercharged, intercooled-supercharged and *Supairthermal* types covering a range of 265 to 4260 hp.

Both engines economically burn natural gas, butane, propane, manufactured gas and sewage gas. Other gases of lower BTU content can also be used, but at reduced ratings. The same basic heavy-duty construction features are used here as in the other Nordberg 4-cycle diesel engines. Where gas is available on the seasonable basis, the spark-fired gas engines have the additional advantage of being convertible to 100 per cent fuel oil or dual-fuel operation. Fuel is metered by a governor-controlled gas metering valve. In the FSE-9 series, the gas inlet valve in the cylinder head is mechanically operated, and on the FSE-13 series, it is hydraulically actuated.

Another operating advantage is thermal efficiency. This efficiency ranges in excess of 41 per cent with the *Supairthermal* type engine to 38 per cent with the non-supercharged engine. Efficiency in all Nordberg gas engine types is the direct result of expansion ratios up to 12½ to 1 and controlled air-fuel ratios by variable inlet valve timing.

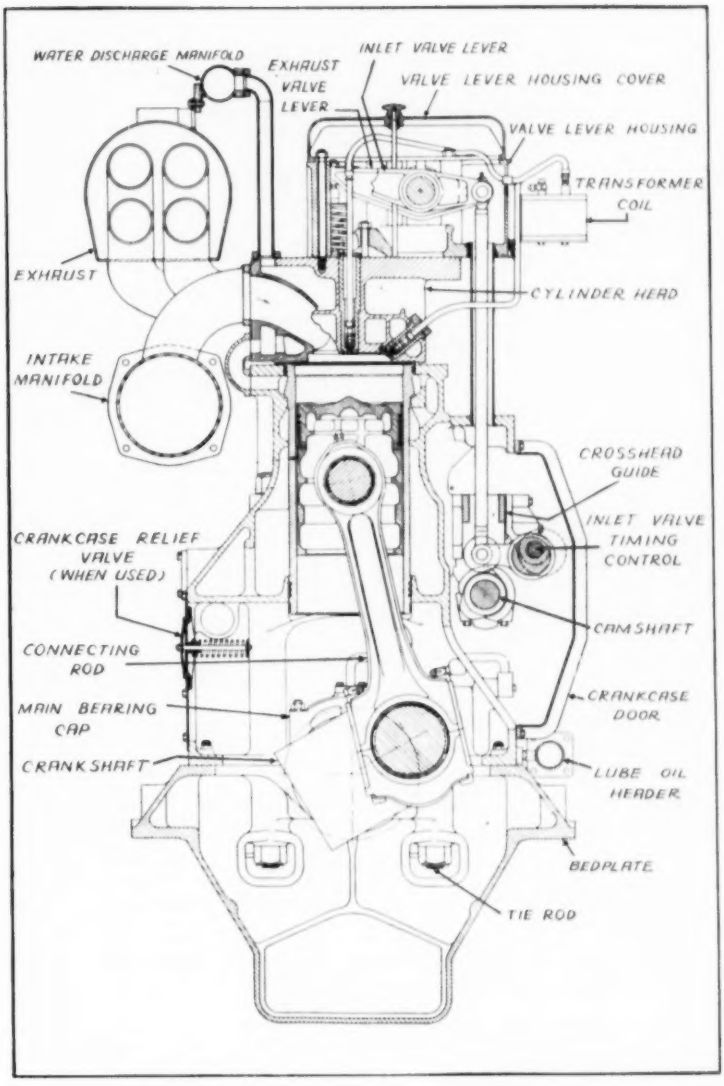
To assure smooth, uniform combustion, the correct air-fuel mixture is maintained by the precise timing of the inlet valve. Compression ratio can be selected to any desired value independent of the expansion ratio. For example, the *Supairthermal* gas engine has a clearance volume 1/11½ of the total cu in piston displacement. At full load, the inlet valve may be closed at a point when the piston has displaced a volume only eight times greater than the clearance volume. This results in a compression ratio of 9, but the expansion ratio of 12½ is maintained. As a result, the engine has the required low compression




Heat balance diagram of a Nordberg Supairthermal spark-ignition gas engine (above).

Operating side of a Type FSE 8-cyl supercharged spark-ignition gas engine developing 490 hp at 600 rpm (left).

Cross-sectional view illustrates design characteristics of the FSE-13 engine (right).




## Details of the spark-ignition gas engine executions added to Nordberg's line of diesel, dual-fuel, and Supairthermal 4-cycle engines.

temperature to operate with minimum excess air without detonating and a high thermal efficiency due to the high expansion ratio.

These gas engines can be operated without pre-ignition or detonation with a mixture having a small percentage of excess air. This is said to be closer to the chemically correct air-gas mixture than obtainable with some other supercharging systems. With this air-gas ratio, combustion is rapid and uniform.

Two ignition systems have been employed on these engines. On the FSE-9 engines, a low voltage impulse type magneto with distributor, external coils, high compression shielded spark plugs and low and high tension cables are used. One spark plug is used in each cylinder. The magnetos generate and distribute low voltage current through the low tension cables to individual coils adjacent to each plug. High voltage current from the coils is then conducted to each spark plug at the proper firing interval of the respective cylinder. An impulse coupling on the magneto provides a hot spark at engine cranking speed and retards the spark automatically to insure easy starting.

The ignition system used on the FSE-13 engines consists of a Bosch impulse generator, selenium rectifier which generates electrical impulses similar to a half-cycle of a conventional AC wave, transformer-coil and spark plug resistors. Two spark plugs are used in each cylinder and are mounted in water cooled holders. The generators produce an ignition impulse which is accurately timed with the firing point of each cylinder. The principles employed in this generator eliminate the use of the conventional cam and break point arrangement usually found in ignition systems.

These spark-fired gas engines are well suited for pipe line pumping service, oil refining and production, industrial and municipal power plants, public utilities, sewage plants, oil well drilling rigs, etc. Several 13-in bore, 6- and 8-cyl engines are now on order for pipe line pumping service.

# Applying Fuel Injection Equipment to Diesel Engines

By F. DeLuca and P. G. Burman*

**These calculations relating to application of fuel injection equipment to diesel engines and the convenient nomograms will be of interest to engine designers in particular. Others in the field will have opportunity to refresh their ideas concerning action and interrelation of system components.**

APPLICATION of fuel injection equipment to diesel engines requires a knowledge of both engine and injection equipment characteristics. While many of the factors involved are well known by the injection equipment manufacturers, they have not generally been used extensively by the engine designer. This article attempts, therefore, to give some of the means which have been used in the preliminary selection or analysis of injection equipment for diesel engines.

## Fuel Quantity Requirement

Petroleum fuels used in internal combustion engines consist of hydrogen and carbon with a carbon-hydrogen ratio varying from 6 to 8. On the basis of the stochiometric equations, the complete combustion of the carbon and hydrogen may be dealt with separately as follows:

$$C + O_2 = CO_2$$

Substituting their molecular weights

$$12 + 32 = 44$$

likewise $2H_2 + O_2 = 2H_2O$

and $4 + 32 = 36$

From the above it is apparent that 1 lb of hydrogen requires $\frac{32}{4}$ or 8 lb of oxygen for its complete combustion, and 1 lb of carbon requires $\frac{32}{12}$ or 2.667 lb of oxygen for its complete combustion. Since 1 lb of air contains 0.2315 lb of oxygen, 1 lb of hydrogen requires $\frac{8}{0.2315}$ or 34.5572 lb of air, and 1 lb of carbon requires $\frac{2.667}{0.2315}$ or 11.5191 lb of air for complete combustion.

Thus, for 1 lb of an average fuel that contains one part hydrogen and seven parts carbon, 14.4 lb of air are required for complete combustion; or,

$$\frac{34.5572 + (7 \times 11.5191)}{8} = 14.4$$

Under normal temperature-pressure conditions, 14.4 lb of air occupy 178.6 cu ft. One pound of fuel having a sp gr of 0.85 occupies a volume of 32.6 cu in or 0.01888 cu ft. Thus, the volume of air required to burn completely 1 cu ft of fuel oil is $\frac{178.6}{0.01888}$ or 9450 cu ft. In general, therefore, it can be stated that the minimum volume of air required to burn completely a typical commercial fuel oil is about 10,000 times the volume of the oil itself.

As most diesel engines operate at full load with about 50 per cent more air than is chemically necessary for complete combustion, the ratio of fuel to air becomes $\frac{1}{9450 \times 1.5}$ or $\frac{1}{14{,}170}$. Assuming a volumetric efficiency of 85 per cent, the fuel required by an engine of 4¾-in bore by 6½-in stroke (115 cu in piston displacement), would be $\frac{115 \times 0.85}{14{,}170}$ or 0.00691 cu in per injection.

## Units of Measurement

To describe the displacement of an engine cylinder as 0.00246 cu yd or 0.0666 cu ft would not give a very clear picture of the size of the engine. Likewise, in describing the displacement of a fuel injection pump, the displacement must be represented in units that define clearly the magnitudes involved.

The metric system enables use of smaller units so that minute volumes can be represented by whole figures. By selecting as the units of measurement the millimeter, which is 0.0394 in or slightly larger than 1/32 in, this volume of 0.00691 cu in becomes 113 cu mm. Comparing 113 with 115, the displacement of the pump then attains practical significance. *For a normally-aspirated engine a convenient rule for engine full load fuel requirements is 1 cu mm for each cu in of engine piston displacement.*

For supercharged engines, the full load fuel quantity (Q) in cu mm per stroke can be expressed approximately as, Q =

$$\frac{(\text{Atmospheric Press.} + \text{Supercharged Press.})}{14.7} \times (\text{engine piston displacement})$$

## Calculating Fuel Requirement

(1) The above are merely thumb rules for the requirement of fuel by an engine. The actual fuel requirement (Q) can be determined accurately only from actual or expected engine performance by the following relation:

*The authors, both of American Bosch Corp., are, respectively, Engineer in Charge, Fuel Injection Laboratory and Engineer in Charge, Special Research and Development Projects.

$$Q = \frac{\text{bhp} \times S \times 454000}{60N\lambda} = \frac{7560\ \text{bhp} \times S}{N\lambda}$$

in which (bhp) is the brake horsepower per cylinder; (S) is the specific fuel consumption, lb/bhp/hr; (N) is the pump speed in rpm; ($\lambda$) is the fuel specific gravity; and 454000 cu mm, volume of 1 lb of water.

This relation is represented by the alignment chart in Fig. 1. Referring to the example, draw a line connecting 1050 rpm and 35 hp/cyl on their respective scales, and continue the line to intersect the pivot line (A). Next, draw line from 0.85 sp gr to 0.41 lb/bhp/hr, and continue to intersect pivot line (B). The fuel quantity, (Q) = 120 cu mm per stroke, is determined by connecting the intersection points on pivot lines (A and B).

(2) When engine size, mep and specific fuel consumption are available, alignment chart in Fig. 2 can be used. For the example shown in this chart, a line is drawn connecting the 5.5-in bore and 6-in stroke to intersect the piston displacement scale at 142 cu in. The next step is to connect the piston displacement and the mep at 100 psi to intersect the pivot line (A). A line is then drawn through the fuel sp gr points 0.85 and 0.40 lb/bhp/hr specific fuel consumption and continued to intersect pivot line (B). The fuel quantity, 130 cu mm per stroke, is then obtained by connecting the points of intersection on both pivot lines.

## Nozzle Orifice Area Required

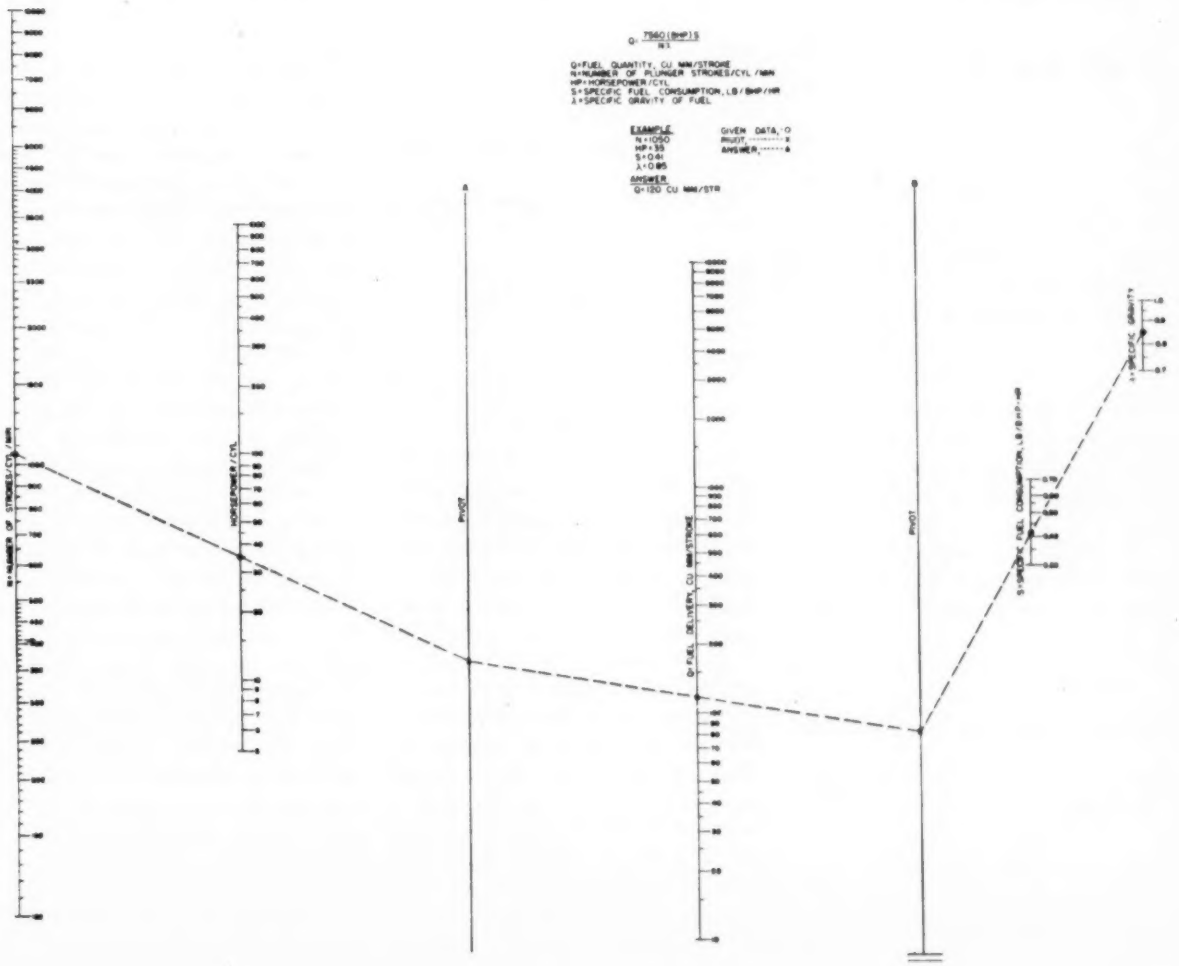
Nozzle orifice area, injection pressure, and duration of injection are interrelated and each factor cannot be determined without knowledge of the others. Although in injection applications it is difficult to determine instantaneous injection pressures for the complete injection process by simple analytical means, it is possible to obtain estimates of the various functions in order to establish a starting point from which bench or engine tests can begin. Examination of the following analysis indicates the extent to which the relationship can be applied:

The quantity of fuel discharged through an orifice is:

$$Q = C_d V A t \qquad \textit{Eq. 1}$$

in which (Q) is the quantity of fuel discharged per stroke in cu mm; ($C_d$) is the coefficient of discharge; (V) is the velocity of the fuel issuing from the orifice in mm/sec; A is the total orifice area in sq mm; and, t is the time of injection in sec.

**Fig. 1**



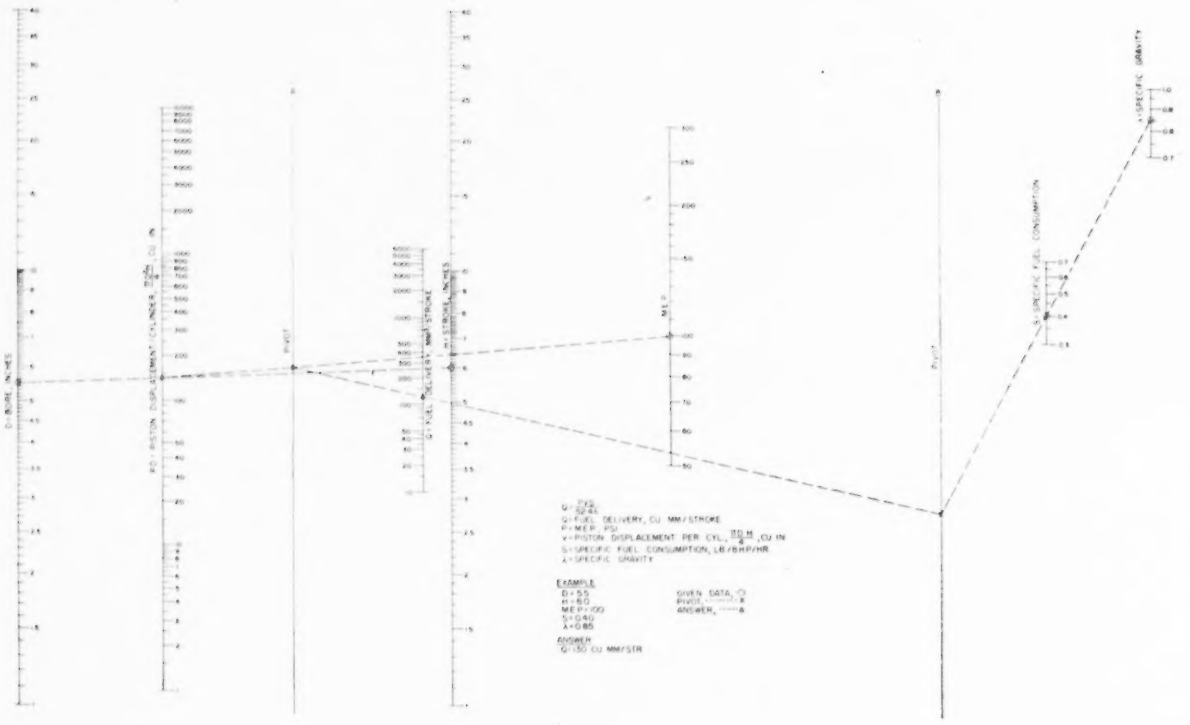


**Fig. 2**

Injection duration in sec is:

$$t = \frac{60}{N} \times \frac{\theta}{360} = \frac{\theta}{6N} \text{ sec} \qquad Eq.\ 2$$

($\theta$) being equal to the angle of camshaft rotation during injection, and (N) the cam rpm.

The fuel velocity at the nozzle orifice is,

$$V = \sqrt{2gh} \qquad Eq.\ 3$$

where (g) is the acceleration of gravity in mm/sec$^2$ = 9800 mm/sec$^2$, and (h) the height in mm of a fuel column equivalent to the injection pressure.

A column of water 1-in sq and 12-in high, weighs 0.4335 lb. It follows that 1 psi pressure is equivalent to $\frac{12}{0.4335} \times 25.4 = 704$ mm high column of water and $\frac{704}{\lambda}$ in of fuel oil. ($\lambda$) being the sp gr of fuel oil.

Therefore,

$$h = \frac{704}{\lambda} P$$

and

$$V = \sqrt{2 \times 9800 \times \frac{704}{\lambda} P}$$

$$= 3710 \sqrt{\frac{P}{\lambda}} \text{ mm/sec} \qquad Eq.\ 4$$

Substituting the various factors in *Eq. 1*,

$$Q = C_d \times 3710 \sqrt{\frac{P}{\lambda}} \times A \times \frac{\theta}{6N}$$

$$\text{or} \quad A = 0.0016 \frac{QN}{\theta C_d} \sqrt{\frac{\lambda}{P}} \qquad Eq.\ 5$$

$$\text{or} \quad P = 2.6 \times 10^{-6} \frac{Q^2 N^2 \lambda}{\theta^2 A^2 C_d^2} \qquad Eq.\ 6$$

These relations are shown graphically in Fig. 3. In general, five of the six factors of *Eq. 5* and *6* are known or assumed and one is desired. Fuel quantity, coefficient of discharge and fuel sp gr are known because of the existing problem. Then, on the basis of the duration of injection and injection pressure desired, the necessary orifice area can be determined. Or, on the basis of duration of injection desired and nozzle orifice area available, the resultant injection pressure can be determined. Still, if the injection pressure desired and the available nozzle orifice area are known, the duration of injection in cam degrees that can be expected can be obtained.

Referring to Fig. 3, for the problem indicated, draw a vertical line starting from 120 cu mm/stroke fuel delivery to intersect the 1500 rpm line; then, from the point of intersection on the 1500 rpm line draw a horizontal line to an estimated 0.34 sq mm orifice area line; from this intersection draw a vertical line to the ($C_d$) = 0.7 line, a horizontal line to the desired duration of injection = 14 deg line, and then a vertical line to the pressure scale corresponding to 0.85 sp gr. The resultant pressure is 6400 psi.

The chart need not be worked from one end and carried directly through to the other. If necessary, it can be started from both ends to determine any unknown factor in between.

For large, low-speed engines with fuel quantities ranging from 1000- to 5000-cu mm per stroke, the chart shown in Fig. 4 is used. If the fuel quantity still exceeds that given in this chart, the problem can be solved on the basis of using half the fuel quantity, all other factors remaining the same. If the duration of injection is the factor being determined, it is necessary then only to double the duration obtained from the chart to give the desired answer.

## Power for Pump Drive

Frequently it is necessary to know the power required to operate the injection pump. Little test data are available to cover all possible combinations of injection systems used on the great variety of diesel engines in use today, but *Eq. 8* below, developed from the basic hp relation *Eq. 7*,

$$HP = \frac{PLAN}{33{,}000} \qquad Eq.\ 7$$

has been found to give results adequate for most applications.

In basic formula *Eq. 7*, values represented are: (P) the average pressure in psi; (L) stroke of the pump plunger in ft; (A) plunger area in sq in; and (N) number of plunger strokes per min.

$l = L \times 12 \times 25.4$ ft in which (l) is the plunger stroke in mm

and $a = A \times 645$ sq in. in which (a) is the plunger area in sq mm and 645 the number of sq mm in 1 sq in

$$LA = \frac{la}{12 \times 25.4 \times 645} \quad \frac{V}{196{,}700}$$ in which (V) is the plunger displacement in cu mm.

Substituting LA in *Eq. 7*,

$$HP = \frac{PVN}{33{,}000 \times 196{,}700}$$

$$HP = \frac{PVN \times 10^{-9}}{6.5} \qquad Eq.\ 8$$

(P) in *Eq. 8* is the *average* injection pressure. However, since average injection pressure cannot be measured, and also since the force of the plunger spring and pump drive friction is neglected, use of the *maximum* injection pressure is recommended and generally substituted for (P).

*Eq. 8* is shown graphically in Fig. 5. A typical example is worked out by connecting (V) = 130, which represents the fuel delivery of 130 cu mm/stroke plus the delivery valve retraction volume of 50 cu mm with (N) = 2000 rpm. Then, connect the pivot intersection point with maximum injection pressure point (P) = 6000. The point 0.34 at which this line intersects the hp scale is the average power required to operate the pump.

## Nozzle Coefficient of Discharge

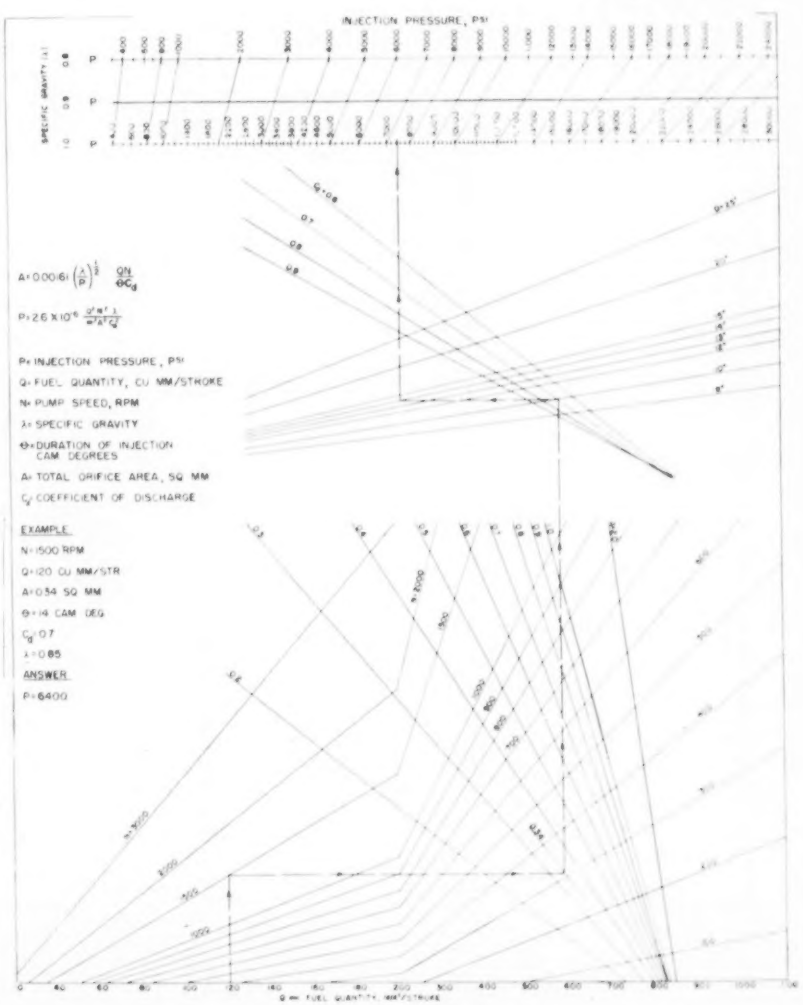
The coefficient of discharge which is the ratio of the actual to the theoretical rate at which fuel issues from an orifice, reflects to a great extent the characteristics of the nozzle orifice. Considerable work has been done by several investigators on coefficients of discharge for diesel engine fuel injection nozzles. Notable, A. G. Gelalles of NACA, in his Report No. 273, confirmed that for a sharp-edge orifice the coefficient of discharge is about 0.65, and significantly with commercial hole-type nozzles, the coefficient of discharge ranges between 0.60 and 0.70, or averages 0.65.

The discharge coefficient actually has little significance since all that is necessary to increase the quantity of fuel that can be discharged by a nozzle is to increase the orifice size. However, the coefficient does reflect on the condition and characteristics of the nozzle.

For example, with a high coefficient of discharge, the orifice is characterized by a smooth, well-rounded edge and the spray penetration is greater than that for a low coefficient nozzle which has sharp-edged orifices. With the latter, atomization is increased and penetration reduced, due to the increased turbulence of the issuing spray. This latter condition is preferred in high-speed, small-bore, open-chamber engines, which occasionally suffer from over-penetration of the spray resulting in fuel impingement on the engine piston or cylinder wall.

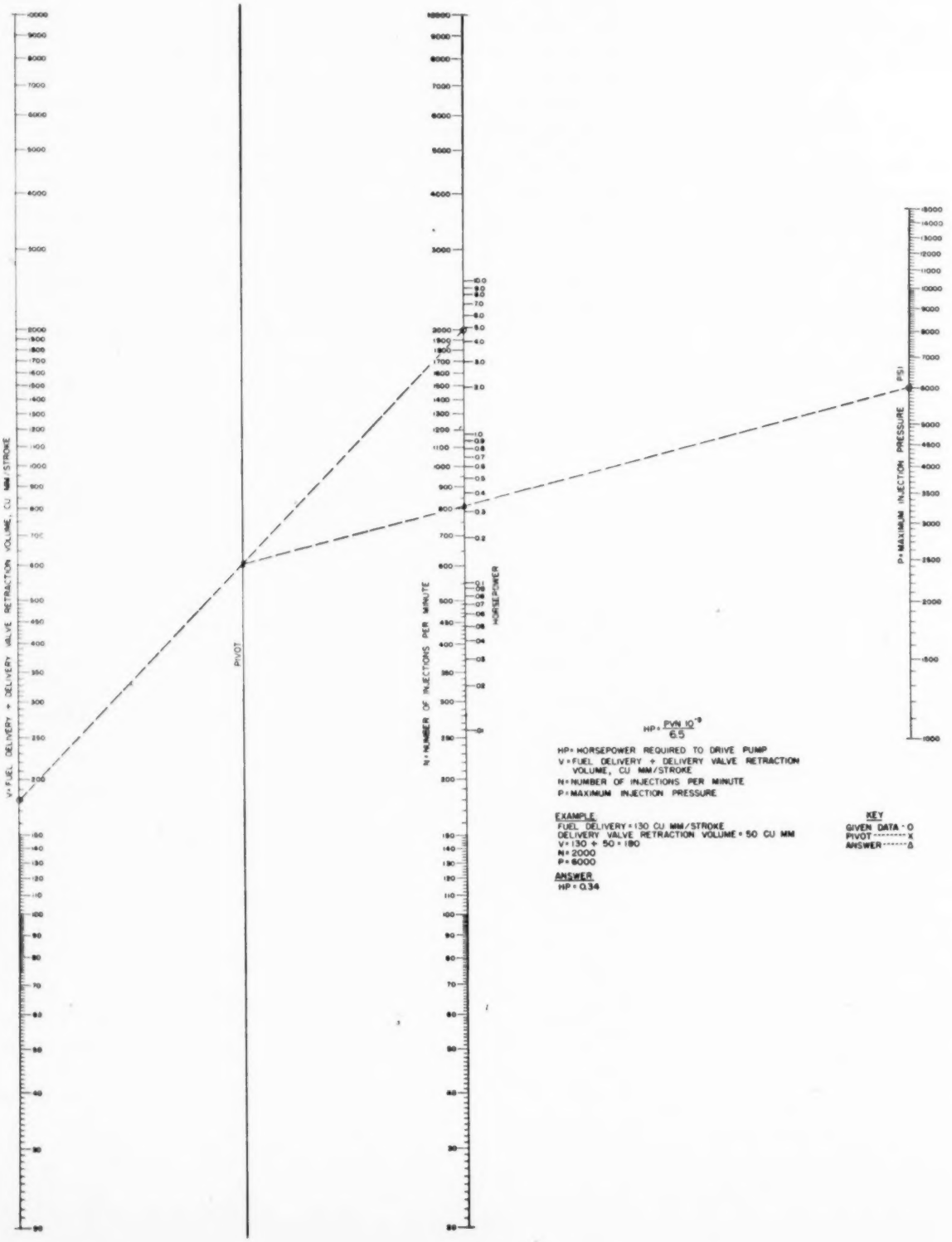
Discharge coefficient is important with respect to pump calibration, as the effective orifice area of a nozzle influences to some extent the quantity

**Fig. 3**


INJECTION PRESSURE, PSI
SPECIFIC GRAVITY (λ)
P = INJECTION PRESSURE, PSI
Q = FUEL QUANTITY, CU MM/STROKE
N = PUMP SPEED, RPM
λ = SPECIFIC GRAVITY
Θ = DURATION OF INJECTION CAM DEGREES
A = TOTAL ORIFICE AREA, SQ MM
$C_d$ = COEFFICIENT OF DISCHARGE
EXAMPLE
N = 1500 RPM
Q = 120 CU MM/STR
A = 0.54 SQ MM
Θ = 14 CAM DEG
$C_d$ = 0.7
λ = 0.85
ANSWER
P = 6400
Q = FUEL QUANTITY, MM³/STROKE

of fuel discharged through the nozzle at a fixed pump rack setting. This effect on pump calibration, however, also is influenced to a greater or lesser degree by the type of delivery valve used, and whether a delivery valve is used at all. Injection pumps employing the conventional single-acting poppet-type delivery valve are least affected by variations in nozzle orifice size, whereas pumps with two-way or duplex-type delivery valves are more critically influenced.

Injection pumps employing no delivery valve, however, are most af-


V = FUEL DELIVERY + DELIVERY VALVE RETRACTION VOLUME, CU MM/STROKE
PIVOT
N = NUMBER OF INJECTIONS PER MINUTE
HORSEPOWER
P = MAXIMUM INJECTION PRESSURE
PSI
$HP = \frac{PVN\ 10^{-9}}{6.5}$
HP = HORSEPOWER REQUIRED TO DRIVE PUMP
V = FUEL DELIVERY + DELIVERY VALVE RETRACTION VOLUME, CU MM/STROKE
N = NUMBER OF INJECTIONS PER MINUTE
P = MAXIMUM INJECTION PRESSURE
EXAMPLE
FUEL DELIVERY = 130 CU MM/STROKE
DELIVERY VALVE RETRACTION VOLUME = 50 CU MM
V = 130 + 50 = 180
N = 2000
P = 6000
ANSWER
HP = 0.34
KEY
GIVEN DATA - O
PIVOT ------- X
ANSWER ------ Δ

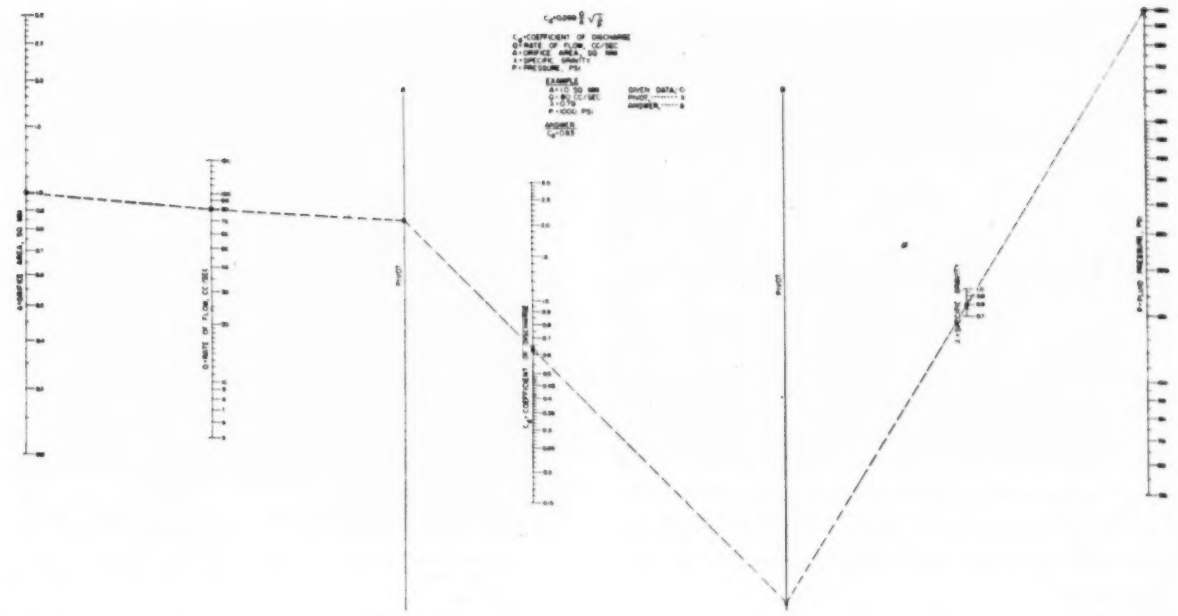


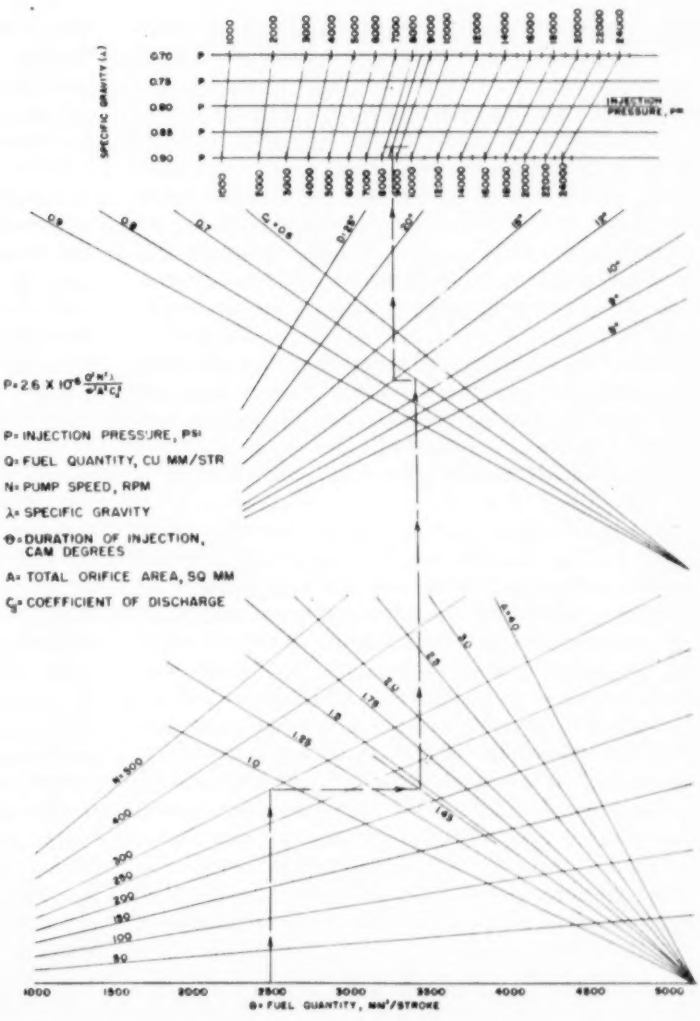
**Fig. 5** **Fig. 4**

**Fig. 6**

fected. Therefore, an occasional check of the discharge coefficient based on the nominal mean orifice area serves as a satisfactory means of controlling the effective orifice area of the hole-type nozzle.

Coefficients of discharge for pintle type nozzles are of little value, as the pintle nozzle by nature is a variable orifice nozzle predominantly controlled by the nozzle valve lift which is variable and unpredictable throughout the engine load and speed range.

The nomogram shown in Fig. 6 provides easy determination of the coefficient of discharge of any single or multiple-orifice nozzle. The example shown is for a given total orifice area (A) of 1.0 sq mm; rate of flow (Q) of 80 cc/sec; fuel sp gr of 0.79; at a constant fluid pressure (P) of 1000 psi. Connect orifice area 1 sq mm and rate of flow 80 cc/sec, and continue the line to intersect pivot line A. Then draw a line from constant flow pressure 1000 psi through fuel sp gr 0.79 and continue to intersect pivot line (B). Finally, connect intersected points on pivot lines (A and B) and intersection of coefficient of discharge scale at 0.63, which represents the resultant coefficient value.


P = 2.6 X 10⁻⁶ Q N λ / θ A C_d
P = INJECTION PRESSURE, PSI
Q = FUEL QUANTITY, CU MM/STR
N = PUMP SPEED, RPM
λ = SPECIFIC GRAVITY
θ = DURATION OF INJECTION, CAM DEGREES
A = TOTAL ORIFICE AREA, SQ MM
C_d = COEFFICIENT OF DISCHARGE
SPECIFIC GRAVITY (λ)
INJECTION PRESSURE, PSI
θ = FUEL QUANTITY, MM³/STROKE

# Diesel Fork Lifts for Safety and Economy

*By L. C. Daniels**

**Advantages of light-weight high-speed diesels are being recognized in many new applications. Here is an application where diesel may very well replace both gasoline and electric power to a very great extent.**

*Buda's model FTD30-24 diesel-powered fork lift ready to go to work. Plenty of power with economy and safety make such rigs pay off.*

Need for safer, more economical materials handling equipment has prompted the adaptation of diesel engines for use in fork lift trucks. There are at least two good reasons for this—safety and economy.

Economy of diesel operation has long been an established fact, and with very good reason. However, economy is only one inherent feature of diesels that can be applied in solving some of the problems encountered with the use of gasoline and electric power in fork lift trucks. For example, in handling various material, working areas may be poorly ventilated or have a potentially explosive atmosphere.

It is in this type operation that safety is an overbearing factor. Therefore, with the diesel having proved its worth in underground mining operations, where conditions such as those above must frequently be dealt with, it seemed that the diesel was the answer to a major part of the problem.

The area in which a gasoline or electric truck can safely operate depends upon the hazards involved. To illustrate this point, a standard electric unit would be unsafe when operating in a potentially explosive dust-laden atmosphere, due to possible arcing at the contactors or controls; or a gasoline-powered unit would be unsafe in a poorly ventilated area due to carbon monoxide content in the exhaust gases. As a result, an attempt was made to reduce or eliminate the possibility of fires or explosions caused by gasoline or electrically-powered units. However, this meant additional equipment and higher initial and maintenance costs, as can be readily seen in the following paragraphs.

In the case of electric units, all wiring was shielded and motors, contactors, and batteries enclosed in gas-tight compartments. This prevents conductive material from falling across the terminals, or dust accumulating and shorting them out. In addition, these gas-tight battery boxes must be purged with an inert gas to remove hydrogen formed by the battery, as hydrogen is unstable and presents an explosive hazard.

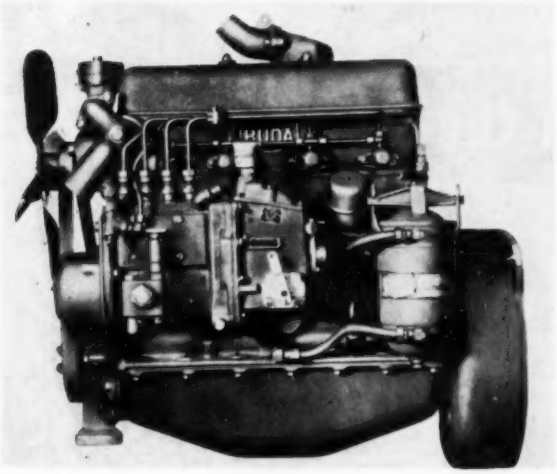
In the case of gasoline-powered units, operated in hazardous areas, there remained the basic problems encountered with electric units, such as sparks from the starter and generator, high tension wires shorting, etc. In addition, hot exhaust manifolds posed another problem in that sparks of hot carbon were blown out with exhaust gases. This was eliminated by the use of water-cooled manifolds and water mufflers.

However, with gasoline-powered equipment, the danger from carbon monoxide was always present and should there be insufficient ventilation, there would be no warning of this danger unless a carbon monoxide detector was used. One approach to this problem was the use of catalyst-type mufflers which could eliminate carbon monoxide from the exhaust gases provided certain specifications were met. With the foregoing being the most important objection to the use of either gasoline or electrically-powered units, let's take a look at what the diesel has to offer.

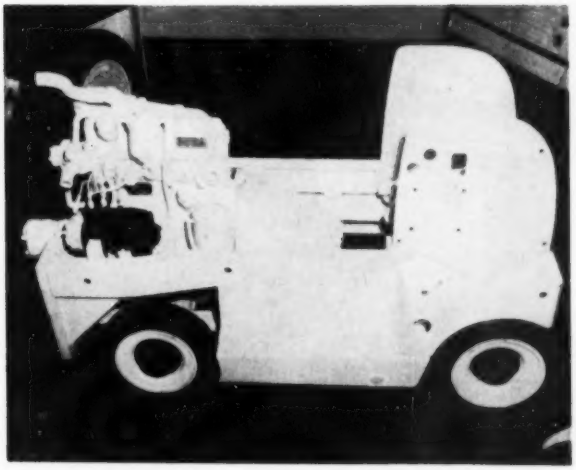
For all practical purposes, we will start with the basic problems encountered in electric units. This can be remedied on diesels very easily, as the diesel does not require an electrical system for ignition and an air or hydraulically actuated starting motor may be substituted for an electric starter. If there are any objections to this type of starting system, an electric starting system may be used in conjunction with a portable battery set-up. With this method, the units are started outside of the hazardous area and the batteries disconnected from the unit by quick detachable couplings. With no batteries on the truck, the starter can do no harm. So much for our electrical problems.

As for the gasoline-powered units, diesels are also free

**Abstract of paper presented by the author at the SAE National Diesel Engine Meeting, St. Louis, Missouri.*



*FTD Series fork lift trucks having a 3000 to 4000-lb lift use Buda's model 4-BD-230 diesel engine without gear box and other take-offs.*



*Engine in the stripped chassis of the 4000-lb lift unit. All of the counterweights, radiator and connections, and sides have been removed.*

from some of the basic troubles encountered with this type of power. Elimination of carbon monoxide is relatively simple and positive, as in a diesel engine, the proper amount of fuel injected can be controlled within a very close range. This means that throughout the life of the diesel, fuel-air ratios can be maintained to the point of complete combustion, thus eliminating the by-product of incomplete combustion—carbon monoxide.

It might be well to point out that there is always a danger of carbon monoxide even with a fuel-air ratio lower than theoretically perfect. This is due mainly to free oxygen not combining with fuel because of fuel concentration in the combustion chamber. In a diesel, this problem is eliminated with proper combustion chamber design. Further, experience as well as Navy tests have proven that carbon monoxide content of the diesel exhaust can be reduced to almost zero, which is, of course, far below what is considered the safe limit.

Another very important inherent characteristic of the diesel is the formation of aldehydes in the combustion chamber. These act as an automatic carbon monoxide safety signal, as when the fuel-air ratio is maintained as mentioned previously, the aldehyde odors are almost impossible to detect. However, should a diesel be operated for a prolonged time in a poorly ventilated area, the smell of aldehydes would serve as a warning long before the carbon monoxide content reached the danger limit.

The problem of hot exhaust manifolds and gases is not as critical in a diesel, due to a more efficient combustion cycle resulting in lower exhaust temperatures. Thus, water-cooled manifolds will transfer less load on the cooling system. Using a water muffler with proper baffling, diesel exhaust gas temperatures can be reduced to about 200°F at the tail pipe. This is considered a safe temperature for practically any hazardous area.

By integrating the above features with the inherent characteristics of the diesel, a source of power is now available which has eliminated the hazards of both electric- and gasoline-powered materials handling equipment.

At this point, a question usually arises—how about additional cost? Initial cost of a diesel-powered unit should not exceed that of a gasoline-powered unit by more than $1000. However, savings on fuel alone will pay for the diesel in a reasonable length of time. Another factor which will offset the initial cost is the increased engine life of the diesel. These savings, based on a five-year write-off, would be sufficient to cover the cost of a diesel engine in a unit replacement program.

Additional savings would apply under certain operating conditions such as stevedoring. To port authorities, gasoline-powered units are considered dangerous, even though no particularly hazardous areas are involved. One main reason for this is the constant danger from fire due to gasoline spillage. For this reason, the port authorities have taken their stand to permit the refueling of diesels on the docks. All gasoline-powered equipment must be taken off the docks for refueling as well as for storage and servicing. Diesel units can be refueled, stored, or serviced on the docks or in the holds of ships.

Restrictions on gasoline-powered units make it necessary to provide storage space and repair facilities as close to the docks as possible. The reasoning behind this can readily be seen, as any time a unit required normal maintenance, adjustment, or refueling, a crew with a tow tractor had to be called. The unit was then towed back to the shop, tuned up, or refueled, then driven back to the dock.

Still another saving can be derived from the use of diesels in stevedoring operations. Pilferage of gasoline, resulting in an average loss of 1 gal. per day per unit, can be controlled. One stevedoring firm operated 100 units with an average loss of 100 gal of gasoline per day. This resulted in $24 per day lost due to pilferage.

Even though the diesel fork lift truck is still in its infancy, the examples cited show great possibilities for new fields where previously fork lift operation presented too great a hazard.

# Straight from the Tool Box

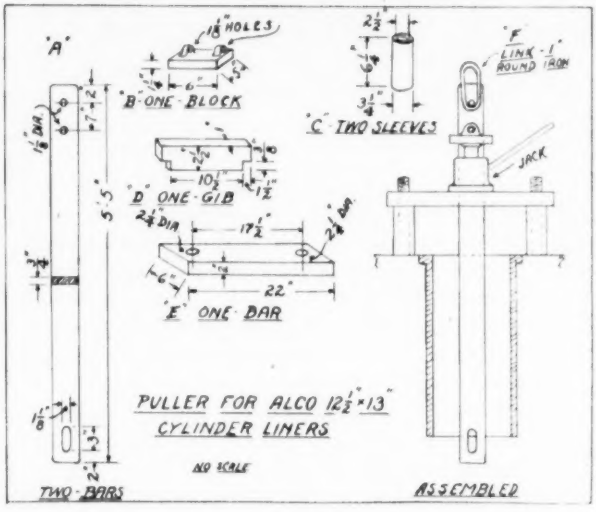
*This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.*

## Puller for Alco 12½ x 13 Liners

C. E. Tucker, Peoria, Illinois—In this letter, I am sending along a sketch giving the details and dimensions of a handy puller that I worked up for pulling the cylinder liners on the 12½- by 13-in engine. Some of your readers might want to make up one.

The sleeves (C) are slipped over the two opposite cylinder studs and the bar (E) is placed over the same studs so as to rest on the tops of the sleeves. The jack rests on the bar. A 1- by 6-in bolt is inserted through the top hole of one puller bar (A), through the lifting ring (F), and then through the other puller bar. A 1- by 9-in bolt is passed through the lower hole in the puller bar, the straps on block (B), and then the other puller bar. The block (B) rests on the top of the jack. The gib (D) is placed through the slots in the puller bars extending below the bottom of the liner, such that the bars rest against the 3/8-in shoulders. This spreads the bars holding them against the inside of the liner while the top edge of the gib bears on the liner bottom.

The jack is operated to pull the liner clear of the press fit. A hoist can then be hooked to the top ring, and the whole business lifted clear and taken away. The length of the puller bars from the gib slot to the inner hole can be changed as necessary to fit any height jack available.




*Looks like a good practical rig and one that can be easily made from materials generally found around a heavy shop. Well within the capabilities of standard tooling, too. By different proportioning of the parts, the general design could no doubt be applied to work with different engines—Editor.*

## Be Careful With Vibration Dampers

George Cooper, Wilkes Barre, Penn.—Some time back, we were running into an occasional engine that was running roughly right after an overhaul. I was finally able on one engine to pin the trouble down to a damaged vibration damper. Maybe the details would be a good reminder to others.

We are running some GM's and they have a viscous-type damper mounted at the fan pulley-end of the crankshaft. In taking these off, some of the boys were hammering on them or using heavy pry bars. Since they are all sealed up and have no exposed working parts, I guess they didn't know what was inside so when they dented them, they had no idea that any harm was done.

I took one that was damaged and carefully cut it to show how the dent was causing a bind. All of the mechanics were called together and shown the general construction, the close clearance of the weight ring to the casing, and the fluid in the unit. It was easy to show how the dent changed the damper into just a small flywheel as a result of binding the inner ring.

I explained that the ring must be free to move, restrained only by the sheer friction of the fluid, in order to dampen impulses that might result in critical vibration in the engine's normal speed range.

Since explaining and showing this to the men, we have had no further trouble, except an occasional accident, from this source. If others are having this trouble, they will find that this sort of education pays.

*Good tip and you're right; education always pays—Editor.*

On the Mesabi Range this 20-tonner hauling iron ore is a Walter Dumper powered by a Waukesha Super-Duty Six 6-WAK Butane Engine

# WAUKESHA Super Duty Six

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**includes**

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**UP TO 352 MAXIMUM HORSEPOWER**

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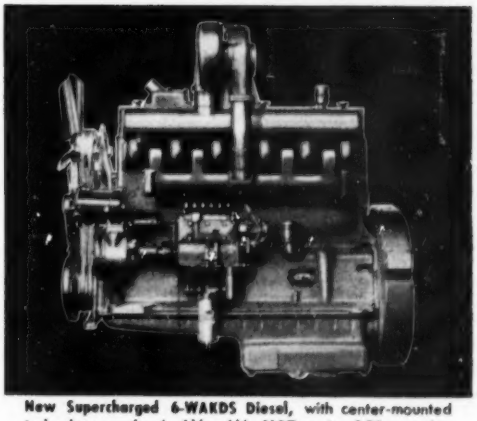

**New Supercharged 6-WAKDS Diesel,** with center-mounted turbocharger; 6-cyl., 6¼ x 6½, 1197 cu. in., 352 max. hp.

**WAUKESHA MOTOR COMPANY** • **WAUKESHA, WISCONSIN**

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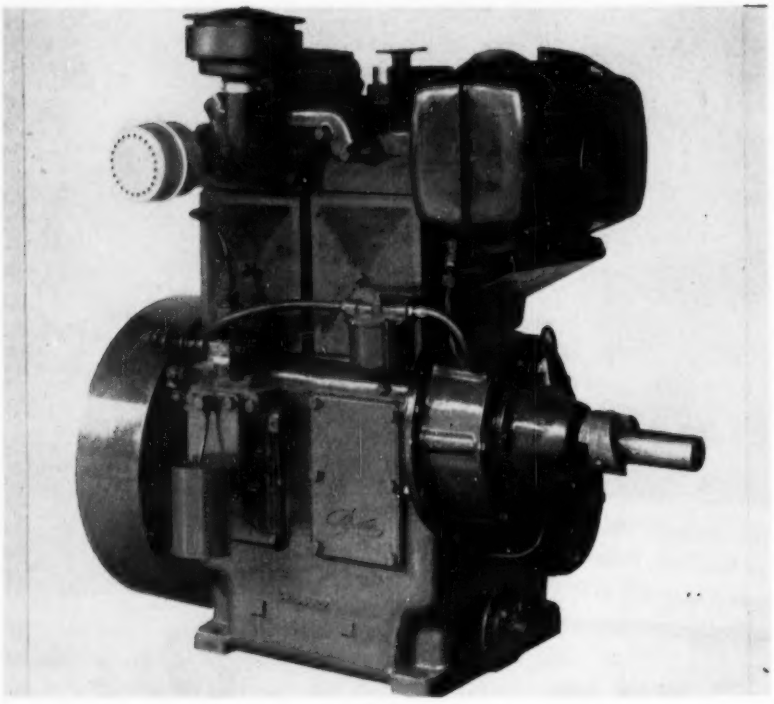
# New Products



### Petter Introduces Compressor Set

Recently, the Petter Small Engine Division of Brush Aboe, Inc., introduced a new unit into its list of products. Without any major alteration to its basic structure, the 2-cyl AV-2 diesel has emerged with one power cylinder replaced by a compressor cylinder. The result is a compact water-cooled air compressor set capable of producing 8 cfm at 350 psi. An alternative rating of 15 cfm at 100 psi can also be obtained.

Versatility of the unit is further enhanced by the retention of the ½-speed output shaft enabling the user to take off up to 3 hp at 760 rpm, for generator or pump service, with the compressor operating unloaded. Apart from cylinder head and piston for compressor, no further spare parts other than standard are required.

The AV-2C compressor unit is suitable for marine auxiliary, mobile or stationary applications. Brush Aboe's Heavy Engine Div. will adapt the unit for standard starting equipment on some of their large engines up to 3000 hp.

### Hydraulic Arbor Press

A new bench type arbor press has been developed by Manzel, 315 Babcock St., Buffalo 10, N. Y. Design tested, the 10-ton press is widely usable in tool room, laboratory or machinery overhaul department. Gauge registering in tonnage is available as optional equipment, with V-blocks and bearing plate furnished. Straightening, material testing, bending, bushing or bearing removal and replacement, etc., are among the many applications claimed for the press.

### Solderless Insulated Terminals

A new solderless terminal developed for intricate control panel wiring has been announced by Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa., known as the Ampli-Bond Terminal. Design assures, it is said, that no underlying conducting surface will be exposed even if the insulating sheath is pierced.

This is accomplished by means of an insulated metal ring near the base of the insulation support sleeve, which while giving strength to combat vibration and sharp bending, does not communicate with the electrical connection farther up the barrel. The terminals are now available in the 12-10 and 16-14 HD sizes and will soon be available in smaller wire sizes.

### New Carbide Sharpening Method

Result of cooperative engineering between Behr-Manning Corp. of Troy, N.Y. and Fenlind Engineering Co. of Rockford, Ill., has produced a new method of sharpening tungsten-carbide cutting tools which costs approximately 2/3 less than conventional diamond-wheel methods, it is claimed, and produces a longer lasting cutting edge. The machine for the method uses as a grinding element, a coated abrasive belt that travels over a cast iron contact wheel specially formulated for extreme hardness.

The abrasive belt procedure is said to eliminate two steps: intermediate grind and finish-honing operations. After clearance angle has been rough-ground, relief angle and final cutting surface can be micro-finished in one operation. Double life of the sharpened tools is claimed over the conventional method. This is accounted for because of the finer finish produced. The machine is called the Fenlind Micro-Finisher.

### Safe Welding of Fuel Tanks

Fuel tanks can now be safely welded, it is claimed, by use of a new "self-emulsifying, self-scouring" solvent, Gunk, being marketed by The Curran Corp., Lawrence, Mass. It is stated that the solvent has a powerful

affinity for, and combines with, all traces of gasoline or volatile fuel to render them completely self-emulsifying so that upon association with water, a safe oil-in-water emulsion is instantly formed that may be completely removed by sluicing with a water hose.

Technique for scouring is to add as much of the solvent as there are traces of liquid fuel remaining in the tank. The tank is then slowly filled with water, which displaces the gas fumes, and the aqueous emulsion formed may then be drained from the tank and the tank freely rinsed with a water hose. After completion of this process, welding can be carried out safely. After welding, the tank can be dehydrated by treatment with alcohol.

## New Diesel Road Roller

Dann Diesel Corporation, Empire State Bldg., New York, N. Y., announces a new diesel road roller of "radically new design", the Dann-Express Triplex. It is said to operate on an entirely new principle, making it "the first major advance in road roller design in almost half a century".

In operation, the roller will automatically exert its maximum pressure on the exact surface point where levelling is required, due to the fact that

all three rollers stay as a single rigid unit. Despite this single unit operation, it is designed for flexibility of movement, having a turning radius of only 8 ft, due in part to synchronized power steering which turns front and rear rollers simultaneously. If required, the middle roller can be raised to allow the machine to operate as a tandem roller.

The single-piece rollers are made of cast steel. All three axles extend the full width of the rollers. The machine is available powered by Cummins or GM diesel, or British Ruston & Hornsby diesel for overseas territories. Model DXR-10 is rated 10 to 13 tons and model DXR-6 is rated 6½ to 8 tons.

## Galvanized Locknut

The Security Locknut Corp., North & 15th Aves., Melrose Park, Ill., announces development of a locknut that can be hot-dipped galvanized. It has a square body and holds its position on the bolt by means of a locking insert. The insert is slightly elliptical and heat-treated. When the nut is applied, the bolt forces the retainer into the round, causing it to grip the bolt with high-tension strength. It does not require bolt tension to stay put and can be removed and replaced any number of times, it is claimed, without losing its locking power or damaging the bolt, and will hold its position wherever it is wrenched. It is designed to answer problems where corrosive elements are present.


here's why it's needed

Overheated jacket cooling water or lubricating oil pressure failure can develop anytime ... and it can happen to the best engine! When this happens, serious engine damage will occur. To prevent such costly damage, engines need the protection given by PENN Safety Controls.

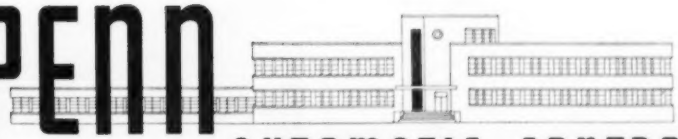
a "MUST" for your engines

here's how it works

If water temperature rises beyond the predetermined safe point ... or if oil pressure falls too low ... the PENN Safety Control goes into action. It automatically sounds an alarm, flashes a warning light or stops engine operation ... whichever you choose. Then, the fault can be investigated and corrected before serious damage develops.

Learn more about this *low-cost* protection for *new and old engines*. Write **Penn Controls, Inc., Goshen, Indiana.** Export Division: 13 E. 40th Street, New York 16, N. Y., U. S. A. In Canada: Penn Controls Limited, Toronto, Ont.

PENN



AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, GAS APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

# ROPER

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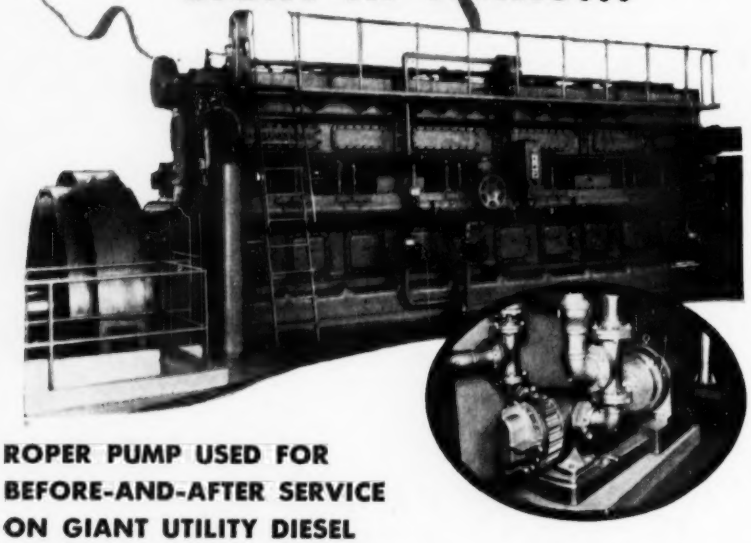
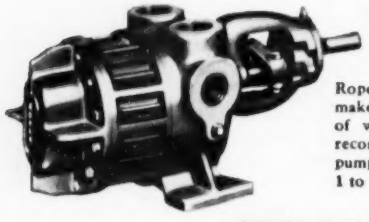
## HELPS TO SHED SOME LIGHT IN TEXAS...



**ROPER PUMP USED FOR BEFORE-AND-AFTER SERVICE ON GIANT UTILITY DIESEL**

In big Texas, a small (by comparison) Roper 25F100 Pump with packed box is used to circulate lubricating oil for before and after operation on a big Fairbanks-Morse dual-fuel diesel. The operators of this Weatherford, Texas municipal power plant use a heavy duty, detergent oil for the lubricating system . . . the motor-driven Roper delivers this oil to bearings and (for cooling) to the pistons. Yes, Roper helps to shed some light and power in Texas . . . and Roper *dependability* is a very necessary quality in such an important installation.



**PLAN WITH ROPER TO DO A JOB FOR YOU**

Roper Series F Pumps have many features which make them widely adaptable to numerous types of work pumping clean liquids. They are recommended for pressures to 300 P.S.I. when pumping lubricating oils. Sizes range from 1 to 300 G.P.M.

**SERIES F FEATURES**

**CONSTRUCTION** . . . Supplied in standard fitted or stainless steel fitted models to suit specific needs.

**GEARS & DRIVE** . . . Two equal size helical pumping gears run in axial hydraulic balance. Shafts are hardened and precision ground.

**SEALS** . . . Packed Box or Mechanical Seal construction available. Models with built-in relief valve can be furnished.

**DESIGN** . . . Roper principle of only 2 moving parts permits simplicity of design . . . such design offers high efficiency and long service life.

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**162 Blackhawk Park Ave., Rockford, Ill.**

**ROPER** *Rotary Pumps*


### Permanent Metallic Filter

The Permanent Filter Corp., 2309 Riverside Drive, Los Angeles 39, Cal., is currently manufacturing a filter, known as Filterall, in which the new filter element is constructed of microporous bronze particles sintered under atmospherically controlled conditions. Various degrees of micronic filtration can be obtained, depending on the application. A recent brochure gives pressure drop versus flow rates for 5, 10, and 20-micron elements per sq in of surface.

The manufacturer points out that in addition to handling normal heavy-duty filtering problems, Filterall will also remove water from the lube oil. Detergents are not removed. They say that since the element is of the permanent type, it can be cleaned readily and re-used, thus eliminating the cost of replacement filter packs.

A diesel fuel oil filter is also produced having the same general characteristics and advantages. Extensive field testing was undertaken, and the unit is proving popular in many applications.

### Torque-Limiting Wrench

A Proto precision torque-limiting wrench without the usual external indicating devices, suitable for nut and bolt torquing, has been announced by the Plomb Tool Co., Washington & Santa Fe, Los Angeles 54, Cal. It is said to differ from conventional types in four respects: releases automatically at proper setting; employs an enclosed precision spring under compression as principal torque-controlling element; uses accurate micrometer adjustment; and, built-in reversible ratchet head models are available to do the work of both ratchet and torque wrench.

Desired torque is set by turning the handle, like a micrometer. When right

torque is reached by pulling handle, the wrench releases automatically and signals operator with a positive reflex action. Upon removal of hand pressure, the torque resets automatically for the next operation. Capacities are 5-75 ft lb or 10-150 ft lb and drive sizes of ⅜ in or ½ in.

### Vacuum Shut-Off Switch

Jaycon Associates, 404 No. Washington Ave., Minneapolis, Minn., are producing a new vacuum switch that shuts off the power source when liquid supply runs dry. The instrument has application as a circuit-breaker or control where the safety of equipment depends on a suction-delivered lubricant, fuel, water, or similar liquid. The switch also serves as a warning control where operating conditions depend on a vacuum.

The switch mounts on the suction line and is wired into the power supply. When suction falls below a predetermined negative pressure, the switch automatically cuts off the engine. It operates on a spring loaded, rubber diaphragm principle. A hand lever is incorporated for manual restart.

### Automatic Lead Bond Device

Knapp Mills, Inc., 23-15 Borden Ave., Long Island City, N. Y., announces a new and versatile automatic machine which will produce a perfect chemical bond between lead and steel. According to the company, in one day one small machine will clad a steel surface requiring 8 to 10 man-days by hand techniques.

With this method the steel is first prepared through leadizing and then lead of any desired thickness can be applied. Lead will not separate from the steel in service, it is claimed, unless it is melted off at temperatures close to 621°F, the melting temperature of lead itself. The machine is a result of pooling the ideas of the company's staff with members of the American Viscose Corp.

### Improved Safety Solvents

Available to industrial and transportation safety and maintenance engineers are three "safe" safety solvents for parts degreasing and equipment

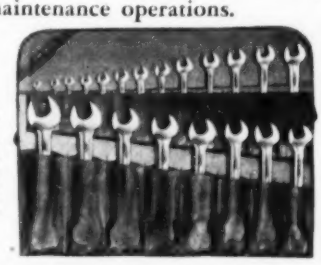

Snap-on*

"Blue-Point Supreme"

Open End WRENCHES

For jobs like this—or where nuts are set in recesses too narrow for other types of wrenches—Snap-on open end wrenches are the strongest, safest made. Every detail of design—the tough alloy steel—precision machining—heat treatment and finishing—are highest quality. In the hands of your workers Snap-on wrenches will contribute greater efficiency to assembly and maintenance operations.

OE-821-K.
21 WRENCH SET
in kit as illustrated. Contains all standard sizes, ¼" to 1⅜". Most sizes duplicated on different handles to meet requirements of many jobs. Complete set, $52.25.



*Write for* Snap-on Industrial Catalog and General Catalog of 4000 hand and bench tools. Snap-on gives direct service to industry everywhere through factory branch warehouses in 42 industrial centers.

SNAP-ON TOOLS CORPORATION
8064-B 28th Avenue, Kenosha, Wisconsin

*Snap-on is the trademark of Snap-on Tools Corporation

cleaning. The solvents are designed to replace carbon tetrachloride and are superior to safety solvents heretofore available, according to the manufacturer, John B. Moore Corp., P. O. Box 3, Nutley 10, N. J.

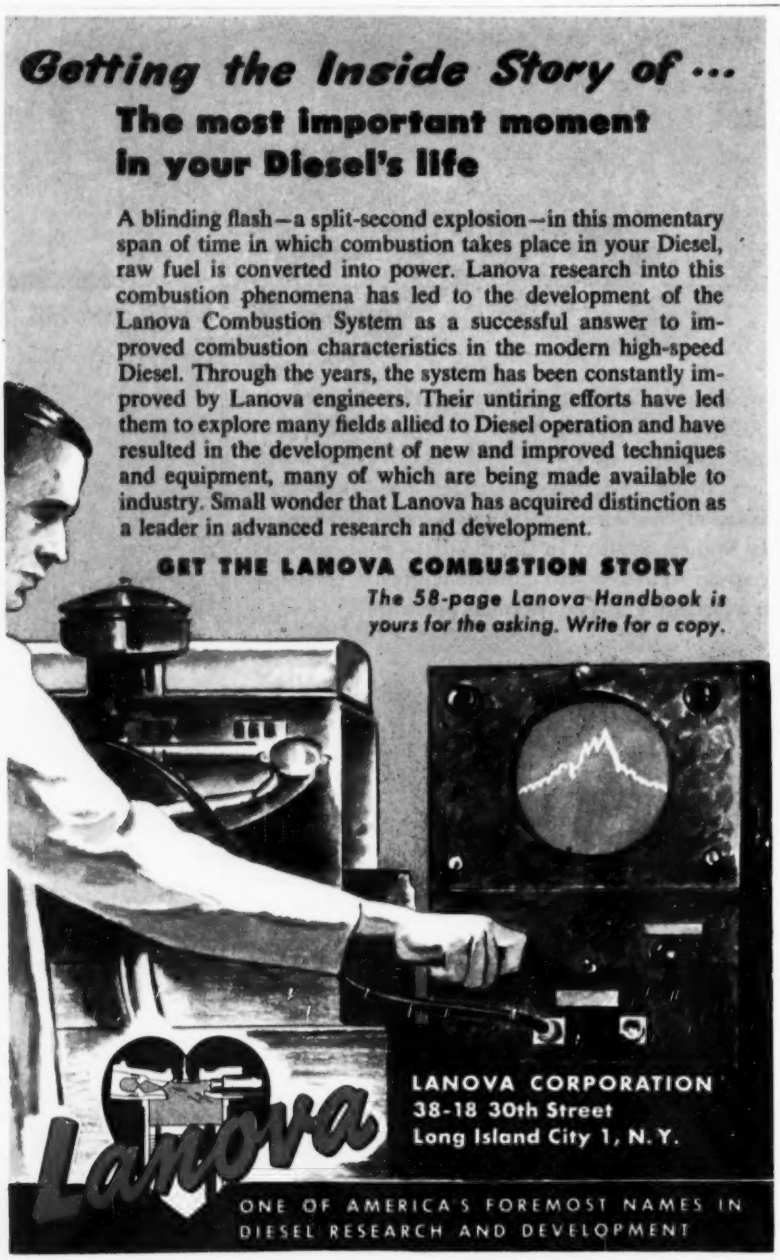
Orthosene is a slow drying solvent, having a flash point of 175°F and degreases without leaving a residual oily film. Per-trolene is a rapid drying solvent, having a flash point of 140°F. Frigisol is a rapid drying solvent capable of displacing water and has a high flash point of 235°F, making it applicable to spot locations where lower-flash solvents might present fire hazards.

## Fast-Heating Soldering Iron

Snap-On Tools Corp., Kenosha, Wisc., announces the R-115A, a lightweight, 2-speed soldering iron. It weighs 9 oz and heats to soldering temperature in 40 sec.

Fast heating is accomplished by use of a 2-speed circuit. Depressing the thumb button on the handle delivers 100 watts at the tip for extra-heavy jobs; the iron idles at 25 watts, once heated, necessary to maintain normal tip temperature for continuous operation.

All tips are plated with Vanderloy, which takes tinning more readily than copper. Six additional styles and shapes are available to interchange with the standard tapered chisel edge tip furnished. The handle is of molded black Durez, said to be shockproof, and a strain reliever holds the cord in the handle to eliminate tension applied to the switch connections. A model for 115-v operation and one for 28-v operation are available.



Getting the Inside Story of ...
The most important moment in your Diesel's life
A blinding flash—a split-second explosion—in this momentary span of time in which combustion takes place in your Diesel, raw fuel is converted into power. Lanova research into this combustion phenomena has led to the development of the Lanova Combustion System as a successful answer to improved combustion characteristics in the modern high-speed Diesel. Through the years, the system has been constantly improved by Lanova engineers. Their untiring efforts have led them to explore many fields allied to Diesel operation and have resulted in the development of new and improved techniques and equipment, many of which are being made available to industry. Small wonder that Lanova has acquired distinction as a leader in advanced research and development.
GET THE LANOVA COMBUSTION STORY
The 58-page Lanova Handbook is yours for the asking. Write for a copy.
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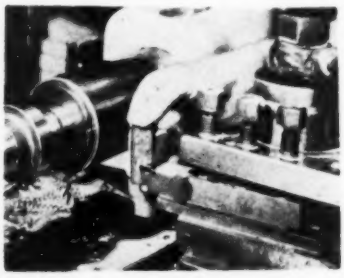
Lanova
ONE OF AMERICA'S FOREMOST NAMES IN DIESEL RESEARCH AND DEVELOPMENT


## New Hone for Carbide Tools

The Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Chicago, Ill., announces a new hand hone specially developed for on-machine sharpening of single-point tungsten carbide tools. The manufacturer claims up to 30 per cent longer between-grinds life results, when the hone is used at first sign of tool dullness.



The user applies a few light strokes over the tool edge, taking care to hold hone flat against surface so as not to round cutting edge or change relief angle. Downtime is cut because the hone touches up tool while it is mounted on machine. Made of silicon carbide, the XL hand hones are available in all wanted sizes.

## Pressure Transmitter

King Engineering Corp., Ann Arbor, Mich., announces a new pressure transmitter, a unit used with pneumatically-operated instruments for measuring the pressure of liquids and gases where a positive seal is needed between the gauging system and the fluid measured.

The transmitter includes a diaphragm that is exposed to the fluid to be measured. Pressure of the fluid on outer side of diaphragm is continuously and automatically balanced by pressure of air supplied to the inner side. This air pressure is transmitted through a tube to the receiver.

Various types of receivers can be used, and two or more receivers can be used with the same transmitter, at different locations. Linear response of the transmitter permits readings accurate to plus or minus ¼ in of water on vented tanks, and plus or minus ¼ in on pressurized tanks.

### Test Stand for Seamed Tubing

An automatic, air and hydraulically actuated test stand for determining the physical characteristics of any seamed tubing up to 3 in in diam, has been developed by the Dommers Co., Wallingford, Conn. Test specimens of steel, stainless steel and carbon steel tubing, it is said, can be readily checked for flaring, column and crushing strength with pressures up to 100,000 lb.

The stand is self-contained, has a hinged safety guard, and requires only a connection of 60-80 lb air supply. Operation is by solenoid, pushbutton control, after the test specimen is inserted between fitting anvils.

### Non-Skid Handles for Hammers

Custanite Corp. P. O. Box 66, Larchmont, N.Y., announces availability of recently developed "Slipruf" coatings on all their hammers and hand drifts. The coating provides a touch friction surface which is durable, grease-proof, and sweat-proof. The non-skid coating reduces chances of accidents and, the company states, fatigue is reduced since much less effort is required to secure grip on the tools.

### Spark Plug Protection

Spar-Kover, manufactured by Lucas Products Co., North Canton, Ohio, is claimed to protect spark plugs from shorting out. The special ceramic cartridge absorbs moisture and condensation around plugs and the watertight cover protects from dew, fog and splashing water. Guaranteed for the life of the ignition system, installation does not require use of tools. They are available for all spark plugs and can be used on any type of ignition fired engine.

### Copper-Jacketed Steel Nail

Fanner Metals Products Co., 2233 E. 67th St., Cleveland, Ohio, is introducing a copper-jacketed steel nail produced by a process developed in Germany. The material used is a heavy-duty steel wire that has a copper jacket molecularly welded to the steel, in which the jacket is uniform over the entire nail including the head. The nails will be available in various lengths, diameters and head sizes, and are claimed to be advantageous since the copper cover makes them invulnerable to corrosion at any point on the surface.

### Catalytic Cell Developed To Reduce Engine Deposits

Solatone, a catalytic cell developed to minimize engine deposits, is being

BEYOND COMPARE
THE FINEST GENERATING AND STARTING EQUIPMENT MADE!
Leece-Neville
L-N GENERATORS
are proving their superiority over conventional standard equipment on thousands of jobs. For 6 and 12 volt systems. High output, long life, reliable performance.
L-N CRANKING MOTORS
High torque, fast cranking speed guarantee quick starts even with cold, stiff engine. For 12 volt and 12-24 volt series-parallel systems. Also higher voltages.
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For short runs, long idling, heavy current needs, nothing equals the L-N AC-DC Alternator System. 25 to 35 amps idling! To 80 amps for 6 volt systems; to 175 amps for 12 volt. Also higher voltages.
★ Now producing cranking motors, generating systems, pump motors and special equipment for military engines.
For all the facts, write THE LEECE-NEVILLE COMPANY, Cleveland 14, Ohio
Distributors in principal cities... Service Stations everywhere
YOU CAN RELY ON Leece-Neville
HEAVY-DUTY ELECTRIC EQUIPMENT FOR OVER 43 YEARS
TRUCK
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RAILROAD
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INDUSTRIAL

produced by A. B. Hydrocarbon Systems, 2808 McKinney Ave., Dallas 4, Texas. It is neither a filter nor a solvent, but is a catalyzer consisting of a metallic shell enclosing a hermetically-sealed catalytic cell.

The manufacturer points out that when a fuel or lubricating oil is in contact with the walls of the cell, a catalytic action is set up immediately creating a "dispersive phenomenon effective in dispersing the mineral molecules and impurities . . . without any chemical modification".

Tests were made on a 2-cyl diesel engine at no-load and 75 per cent load, consecutive for periods of 235 and 330 hr respectively. The catalyzer was placed in the fuel pump supply line to No. 2 cylinder. Photographic results of the tests show that not only was there less carbon and varnish deposits in Cylinder No. 2, but that the carbon there was softer and more powder-like.

The Solatone unit when used with fuel or lube oil, is said not only to prevent formation of harmful engine contaminants and deposits but to remove them following installation. The unit is easily mounted in either the fuel or lubricating oil lines by following simple directions. There are no moving parts and the only maintenance required is replacement of the catalytic cell. This only occurs at relatively long intervals and at low cost.

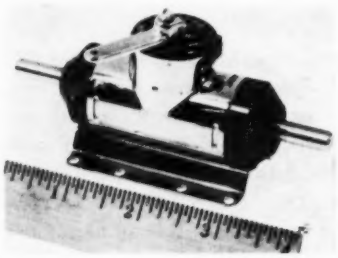
## Improved Pressure Switch

John W. Hobbs Corp., Springfield, Ill., announces improvement on its pressure switch designed for use in connection with engine hour meters. Heavier materials are used for the terminals. The operating diaphragm is now assembled without use of solder.

Use of solder in final assembly is also eliminated, and it is claimed, the new construction makes oil leaks impossible. Ability of the switch to withstand heat and cold has been improved by equalizing pressure in the inside upper chamber with that on the outside of the switch.

## Miniature Speed Changer

Metron Instrument Co., 432 Lincoln St., Denver 9, Colo. is manufacturing a new miniature variable speed changer with lever speed control, with a liimted lever arc of 63 deg. The lever is oriented independent of the pointer to any horizontal position, or can be removed to give a versatile speed control shaft in a vertical axis.



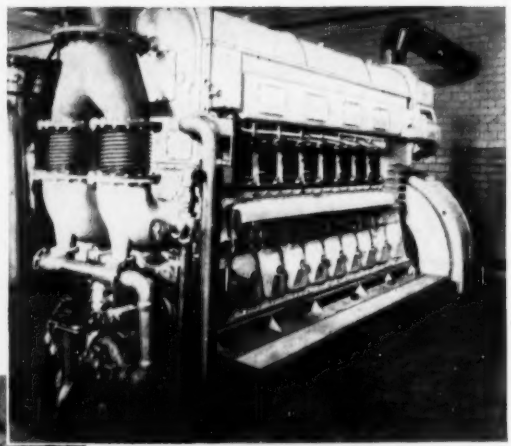
Remote ratio indication on a scale of any size can be arranged by means of a scale associated with the remote speed regulator.

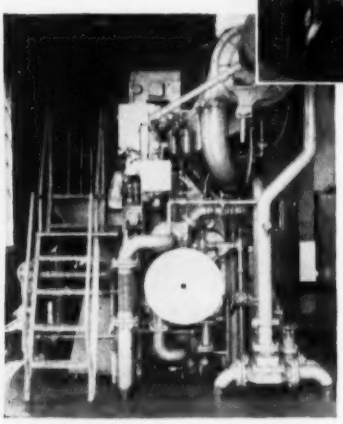
The speed changers are completely enclosed, permanently lubricated, made to close tolerances, and are equipped with ball bearings throughout. They are claimed to be ideal even for military applications where severe ambient conditions are encountered.


**WHENEVER rigid piping or ducts must be connected to engines...**

*CMH Flexible Metal Hose at work on diesel exhaust connectors on a Fairbanks-Morse engine.*

*Below — at work as coolant water hose on a Nordberg diesel.*





**use CMH FLEXIBLE METAL HOSE**

CMH Flexible Metal Hose absorbs engine vibration—isolates the forces that damage rigid piping and loosen exhaust, oil, air and fuel connections. It is also the most economical and dependable method of eliminating piping stresses that result from misalignment or expansion and contraction.

CMH Flexible Metal Hose is available in a wide range of types, sizes and assemblies to meet your needs. Distributors are located in all principal centers. See your classified telephone directory or write for the name of the distributor nearest you.

HERE'S YOUR GUIDE TO MOTION CONTROL

For helpful information on motion control, Write for Bulletin 124.

CHICAGO METAL HOSE Division

Flexonics Corporation

1363 S. Third Avenue • Maywood, Illinois

Manufacturers of flexible metal hose and conduit, expansion joints, metallic bellows and assemblies of these components.

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies CMH products that have served industry for over 50 years.

### Oil Mist Control Unit

A completely designed Precipitron oil mist control unit that will recover the coolant oil from mist and smoke generated by high speed cutting, grinding, milling, and similar machining operations is available from Westinghouse Sturtevant Div., 200 Readville St., Hyde Park, Boston 36, Mass.

The unit is self-contained, a heavy gauge sheet steel cabinet housing the charging and collecting elements, the motor driven fan, duct connection, and oil sump. Fan motors are 3-phase, fractional hp, ball bearing, for 220- or 440-v service. The power pack operates from a single-phase, 115-v line and consumes less than 60 watts when operating. Available in two models, type PO-6 has an air handling capacity of 600 cfm, and PO-12 of 1200 cfm.

### Snap-Tite Couplers

A new design in couplers has just been announced by Snap-Tite, Inc., Union City, Pa. Designed for an 8-in pipe line, the coupler has standard flanged connections; a valve is in the coupler body which automatically shuts off liquid flow when the male part is removed. It is also offered without a valve.

The quick connect feature eliminates the necessity for having a maintenance man with tools available for this operation; any operator can make or break a connection by sliding a sleeve on the coupler (no tools required).

The couplers come in sizes from ¼ in to 8 in. Up to 3 in, the couplers are designed for screwed fitting, male or female, and over 3 in with screwed or flanged fittings. They swivel 360 deg, eliminating hose kinks.

### New Open End Ratchet Wrench

The Tubing Appliance Co. of Los Angeles, Cal., is making commercially available a new ratcheting socket wrench that is open ended, said to save 25 to 90 per cent production and maintenance time. It permits the introduction from any side of the socket, over and completely around a pipe or tube and straight down the fitting.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MACHINE FORGINGS

ELLWOOD CITY, PENNA.

***How much*** of your engine maintenance bill is due to repair of breakdowns that could have been avoided—*if you'd had advance warning?*

At a fraction of that cost, Alnor Exhaust Pyrometers offer you a constant check of engine performance—advance warning of

**Cylinder Overload** **Preignition**
**Scaled Jackets** **Clogged Ports**
**Detonation** **Faulty Injection**

Get the best from your diesel—minimum fuel consumption per horsepower and long service uninterrupted by foreseeable breakdowns. Get constant protection of your engine, cylinder by cylinder, with an Alnor engineered Exhaust Pyrometer System.

***Get Full information***—*Quickly!* Your nearby Alnor Diesel specialist is conveniently listed in the classified directory. Ask him to help you select the Pyrometer and thermocouple assembly designed for your engine. Or send for Bulletin 4361 with complete details of the full Alnor line of Pyrometers.

**ILLINOIS TESTING LABORATORIES, INC.**
**Room 507, 420 N. La Salle St., Chicago 10, Illinois**

The wrench head ratchets by means of internal pawls acting upon teeth cut into a strong ring traveling around the wrench head. As little as 7 deg clearance for the regulation square drive handle will permit normal functioning without danger of bending the tube. The sockets come in 64 sizes from ⅜ in to 4 in.

### Seamless Light-Wall Tubing

Superior Tube Co., Norristown, Pa., announces an increase in the size range of its seamless light-wall tubing from 1¼-in OD maximum to 2 1/16-in OD maximum. Heretofore the larger diameter light-wall tubing has been offered only in welded grades. Increase in size range is expected to increase number of applications of light-wall tubing, particularly where pressures exceed limits for welded tubing.

### High Sensitivity Inverter

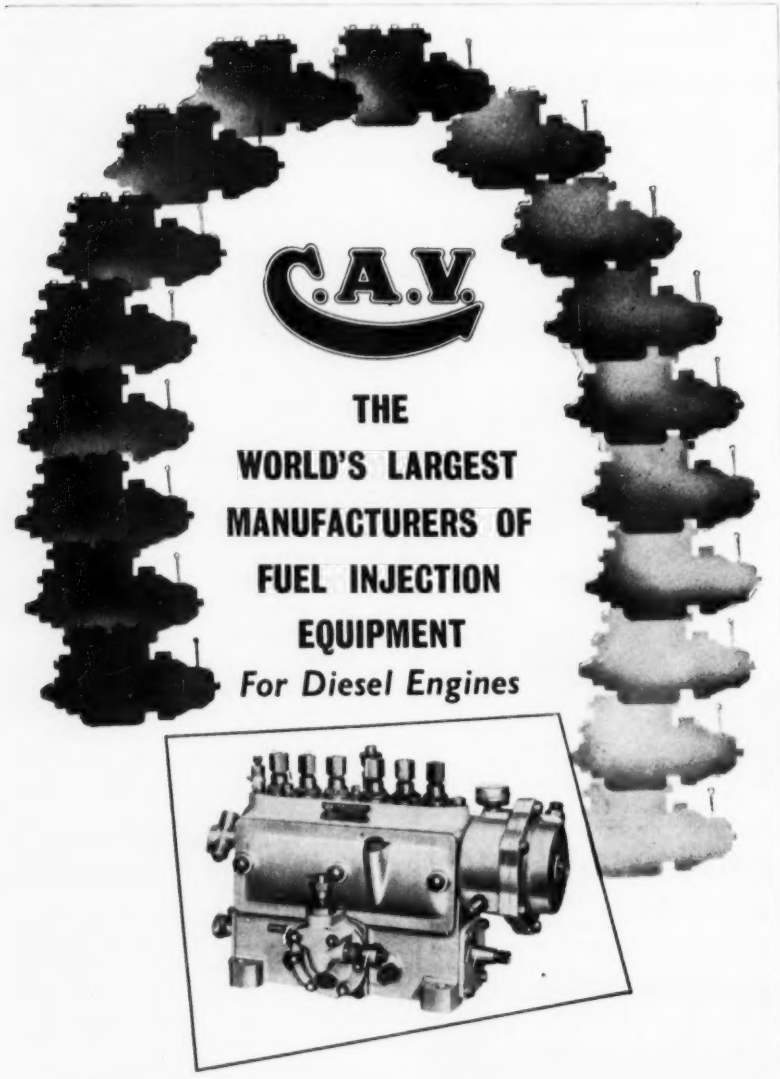
The development of a synchronous inverter, having a sensitivity of 0.05 microvolts and a dissymetry of less than one-half of one per cent, has been announced by the Bristol Co., Waterbury 20, Conn. It is capable of converting low-power DC signals to alternating voltages that can be amplified and applied to electronic, electrical and servo systems.

The switch will operate at any frequency from zero to 3500 cycles. Errors due to thermal emf are eliminated by the use of two single-pole, double-throw contacts. The inverter is free from resonance effects, it is claimed, and hermetically sealed against dust and corrosion.

### Non-Inflammable Cable Clamps

Holub Industries, Inc., Sycamore, Ill., is producing a non-inflammable plastic cable clamp made of Saran, a strong material offering good electrical and thermal properties. It is inert to fungicidal attack and is able to withstand atmospheric changes.

It is claimed not to be affected by prolonged immersion in water, is nontoxic and abrasion resistant. Reduction of weight is another feature. The material is pliable and the clamp can be opened to any dimension. Edges are rounded. Need for lock washers are eliminated in many instances, it is said, because of the clamp's resiliency. Stock sizes range from ⅛ in to 1¼ in.



## New Literature

### Demineralized Water Usage

An 11-page report on the "Uses for Demineralized Water" together with a water analysis study has been prepared by Barnstead Still & Sterilizer Co., 195 Lanesville Terrace, Forest Hills, Boston 31, Mass.

### Insulation Specifications

Johns-Manville, 22 E. 40 St., New York 16, N. Y., has issued a 52-page brochure entitled, "Insulation Specifications for Oil Refineries and Chemical Process Plants." It is designed as a quick reference for engineers and others who must specify thermal insulations in these industries.

Specifications are divided into four main sections: insulations for temperatures above 100°F; insulations for below 100°F; tank insulations; and, oil heater insulations. Seven tables of insulation thickness recommendations

are included. Illustrations show finished work and details of methods of applying insulations.

### Precision Extrusions Catalog

A complete catalog covering over 4000 standard extruded aluminum shapes, rod, bar, and tubing available, has been released by Precision Extrusions of Bensenville, Ill. The 98-page wirebound book includes a 2-page spread compiling in chart form the physical properties and recommended applications for the 14 most generally used alloys. Alloys are listed by number, makeup and uses, alloying elements, temper, least thickness to be worked, tensile strength, and percentage of elongation.

### Shell-Mold Casting Process

Technical advances to enable the manufacturers of metal castings to make better and wider application of the new shell-mold casting process are described in a technical report now available from the Office of Technical Services of the U. S. Department of Commerce.

According to Navy scientists who prepared the report, application of these advances makes possible stronger castings, lower costs, and use for a wider range of metals—iron and steel as well as light metals. Recommendations are presented for the best practice in production equipment and mechanization, investment materials, sands, investment mixing, pattern equipment, gating and heading, dimensional tolerance, closing molds, cores, and plant safety.

The report, PB 111004, entitled, "Report of Investigation of the Shell Molding Process", sells for $1.50.

### Demineralizing by Ion Exchange

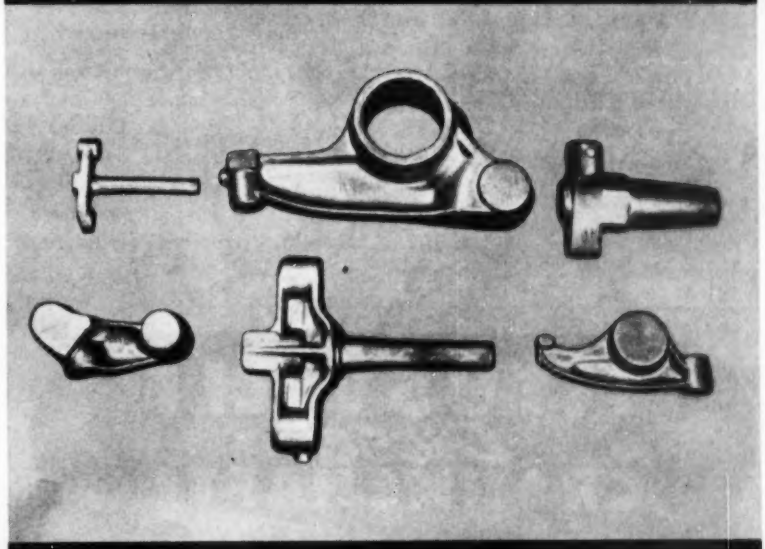
To help explain a new role ion exchange is playing in industry, The Permutit Co., 330 W. 42nd St., New York 36, N. Y., has prepared a 28-page bulletin, "Demineralization Including Silica Removal by Ion Exchange". The new bulletin, 3803, describes the chief applications, principles of operation, design features, advantages, recommendations and specifications of the company's demineralizing and silica removal apparatus and synthetic resins.

### Test Methods for Rating Fuels

The second edition of the ASTM *Manual of Engine Test Methods for Rating Fuels*, incorporates changes in the five standard methods for rating that have been adopted since earlier publication in 1948. Six revised supplements contain information on best practices currently in use for laboratory facilities, installation of engine test units, provisions for reference materials, and electrical, water and air services, with the operation and maintenance of the units. An extensive index is included.

The method applying to diesel fuels, "Tentative Method of Test for Ignition Quality of Diesel Fuels by the Cetane Method (D613-48T)", describes the test procedure for determining the ignition quality of diesel fuels in terms of ASTM Cetane number. Copies can be obtained from the


**Over 50 Years Experience**



**Diesel Engine Forgings**

OVER A HALF CENTURY'S EXPERIENCE from experimental forgings to mass produced products — ability to work at closer tolerances — careful attention to grain flow and fiber formation — rapid service and engineering skill have earned us the reputation for quality and dependability.

INDIANAPOLIS

1300 Madison Ave. Indianapolis 7, Indiana

DROP FORGING CO.

American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., at $3 each.

### Hydraulic Conversion Factors

Noting that little data is readily available for plastic lined, plastic, and light wall steel pipes as compared to standard steel and cast iron pipes, The Permutit Co., 330 W. 42nd St., New York 36, N. Y., has prepared a table, attempting to make friction, velocity and friction head data available for those who deal with the flow of fluids in other than standard steel pipes.

### Building a Modern Refinery

The M. W. Kellogg Co., 225 Broadway, New York 7, N. Y., dramatizes the complex task of erecting a modern refinery in a 4-color drawing of the job-site in a recent issue of *Kellogg-gram*.

The site is illustrated when it is about 75 per cent complete, the drawing depicting an imaginary 100,000-bbl-per day refinery and integrated petrochemical plant, revealing the activities involved in bringing blueprints to reality. Welding, radiography, fabricating, guy derricks in action, heat-treating, structural steel work—units on stream — are shown from the ground up.

### Diesel Engine Attachments

Caterpillar Tractor Co., Peoria 8, Ill., has issued a 32-page booklet, "Attachments for your Caterpillar Diesel Engine", designed for those considering an engine installation. It contains the most complete selection of attachments ever presented by the company in booklet form, starting the reader at the engine base and concluding with a discussion of exhaust devices.

### Extreme-Pressure Lubricant

Sunep, an extreme-pressure lubricant for high-output industrial gearing, is described in a booklet prepared by the Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa. The new lubricant is also recommended for use with heavily loaded plain bearings and screws.

The illustrated booklet outlines the lubricating problems faced by industrial plants in stepping up production with existing equipment and shows how the lubricant helps to solve them. Among advantages claimed are exceptional load-carrying ability, noncorrosive qualities and longer lubricating life.

### Protection Against Corrosion

An illustrated brochure describing the use of coal tar for combatting corrosion has been issued by the Tapecoat Co., 1523 Lyons St., Evanston, Ill. Included are case histories.

### Diesel-Electric Generators

The Export Division of the Belgian Electric Sales Corp. has issued a 4-page bulletin listing ratings and operating data for its Fermont generating sets that can be ordered off the shelf.

### Properties of Weld Metals

The American Locomotive Co., Schenectady 5, New York, features an evaluation of the properties of weld metals for low-temperature service in the new issue of its "Alco Products Review". Discussed are materials used in the fabrication of pressure vessels for low-temperature service, investigation of ferritic electrodes to determine properties of deposited weld metals for low-temperature service, and the Charpy notched-bar properties of weld metals at various levels.

The new issue also features an article describing use of gas-turbine centrifugal-compressor units and regenerators for gas-pipeline pumping on the El Paso Natural Gas Co.'s pipeline.

### Steel Castings Handbook

A second printing of the "Steel Castings Handbook", first published in 1950 to supplant the original edition, has been announced by the Steel Founders' Society of America, 920 Midland Bldg., Cleveland 15, Ohio. This revised volume lists general data on steel castings, specifications, applications, design principles, mechanical and physical properties, and related technical materials. It incorporates 520 pages of text, 440 illustrations, and 120 tables.

**Precision Tolerances and Finishes as your Requirements demand . . . Turn to Titusville for Engineering and Research Counsel—an organization of master Craftsmen with facilities second to none in the industry.**

Struthers Wells

**STRUTHERS WELLS CORP.** *Titusville Forge Division*

TITUSVILLE, PENNA.

# FRAM FILTERS
## *pay for themselves in SIX MONTHS!**

***at Barton Mines Corp., North Creek, N. Y.**

The Barton Mines Corporation works with crystal garnet ore, producing abrasive grains and powders. Three diesel engines in the company's power plant ran in "an exceedingly dusty location," to put it mildly. To combat this condition, Fram lube oil filters were installed. Barton reports these results:

- **Filters paid for themselves in less than 6 months**
- **Liner, ring and bearing wear reduced**
- **Oil after maximum use is as clean as when new**
- **Hard carbon formation on rings and heads minimized**
- **Time between overhauls greatly increased**
- **Lube oil consumption cut in half**

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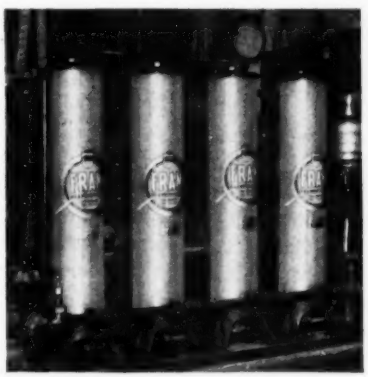

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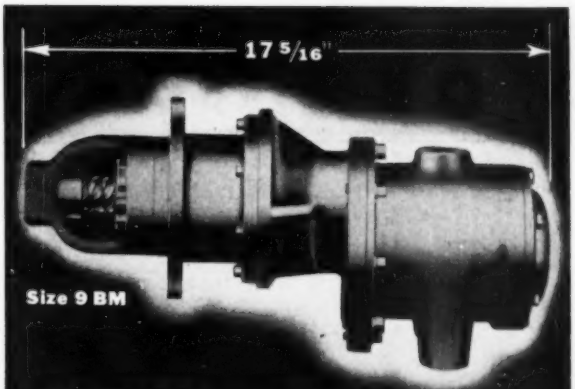


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# Field Notes

### *From Snow Country to Desert*

Two shipments of "F" type EMD locomotives point up the wide versatile qualities of the standardized GM diesel-electric locomotive. One shipment went to Alaska and the other to Saudi Arabia, within a few days of each other.

The locomotives are standard 1500-hp freight units, each with the same basic power plant, transmission, car body, trucks and controls, but with variations in equipment. One set is equipped to cope with the extreme heat and dust conditions of the Arabian desert, and the other to operate successfully in the sub-zero and heavy snow and ice conditions of Alaska.

Six units were shipped to the Alaska Railroad, where they will operate as three, 2-unit, 3000-hp locomotives hauling freight between Anchorage and Fairbanks and between Anchorage and Seward.

The two units shipped to Arabia will operate over the 370-mi line between Bahrein and the capital city of Riyadh. These units are supplied with special air filters to protect engines from dust and sand, (note schnorkel on top).

### Last Steam Locomotive for CPR

"We have bought our last steam locomotive—coal or oil," vice president N. R. Crump, of the Canadian Pacific Railway, revealed recently. In the next five years, the line will acquire 358 diesels and is expected to spend $13,900,000 a year during the period of conversion to diesel units.

Crump indicated that a gas turbine engine, being developed in Canada and to be powered by coal, held the line's interest but was not yet far enough advanced for inclusion in plans.

### R. L. Stanley Joins DEMA Staff

Robert L. Stanley will become a permanent member of staff of Diesel Engine Manufacturers Association with the title of Educational Director. He has been serving the organization in a consulting capacity on a part-time basis for two years.

Mr. Stanley brings to DEMA a background of experience and knowledge that will enable him to be of help to educational institutions. Most of his time will be spent with college professors who teach courses in the diesel engine field.

From 1939 to 1947 he was instructor and assistant professor of engineering at Union College. Since 1947, he has been associate professor of engineering research at The Pennsylvania State College where he has been engaged in diesel engine research. He is a past chairman of Mohawk-Hudson, Society of Automotive Engineers; and Central Pennsylvania Section, American Society of Mechanical Engineers.

### Cylinder Liner Reclamation

The practice of reconditioning worn cylinder liners for diesel engines by recoating their inner surface, using the Porus-Krome process, and honing to their original dimensions, has proven to be economically sound, Baldwin-Lima-Hamilton Corp. makes known in a recent bulletin. However, it is cautioned that cylinder liners selected for this reconditioning be free from defects such as cracks or eccentricity.

Following the company's earlier announcement endorsing this practice and calling attention to the availability of this service to its customers, and the advantage already being taken of it, the program has been expanded to include the reconditioning of liners from Lima-Hamilton engines, as well as the Baldwin engines.

The entire operation is handled by the Van Der Horst Corp., Olean, N. Y., and B-L-H recommends that all orders concerning the re-standard-sizing of Baldwin and Lima-Hamilton cylinder liners, as well as liners to be reworked, be sent to that company.

Baldwin points out that since they do not inspect or otherwise check the material so processed, they cannot assume responsibility. However, Van Der

Horst's excellent reputation, plus the fact that a warranty is given by them for each job, is adequate assurance of satisfaction.

## Rock Island Salutes Centennial With Complete Dieselization

Completion of the dieselization program of the Rock Island Lines in its 100th year of operations was announced recently by J. D. Farrington, president. The program was completed with delivery of 10 GM general purpose 1500-hp road units, signifying that all mainline and branch operations—both freight and passenger—are equipped with diesel-electric power.

The 10 engines cost $1,550,000 and are being placed in freight service. Passenger operations other than a few suburban runs have been dieselized for nearly a year.

The dieselization program was started in 1937 when the first of the streamlined Rocket trains went into service between Chicago and Peoria. This was a major part of the rehabilitation program of Mr. Farrington who had been brought in a year earlier as chief operating engineer to bring the railroad out of chaos.

The diesel power program continued at a fast pace until the war. After that the company again placed heavy orders. The company now has 502 units of diesel-electric power, which includes 89 units for road passenger operation; 255 for freight; and 158 yard switchers. These make up 414 separate locomotives.

## Extend Use of Dynamic Braking On Diesel-Electric Locomotives

Dynamic braking, originally used on diesel-electric locomotives to control speed of trains on mountainous grades, is now being employed increasingly by railroads to control freight speeds in relatively level territory, according to a report by A. V. Johansson and H. R. Stiger of the General Electric Co., at the annual meeting of the American Institute of Electrical Engineers. Extensive service tests have demonstrated the economic and operational value of this form of braking, the engineers stated.

Main difference between dynamic and regenerative braking lies in the method used to dissipate the power produced, it was pointed out. Dynamic braking uses a resistor built into the locomotive. Regenerative braking uses the railroad power system to take energy from the train and employ it elsewhere or dissipate it in resistors at the substations.

Economic advantages of dynamic braking cited are: reduction of number of overheated wheels; elimination of long, costly stops for wheel cooling on heavy grades; reduction in number of thermal cracked wheels; reduction in wheel wear, wearing of brake rigging and attachments; reduction of brake beam and attachment failure and number of derailments caused by this; the ability to reduce train speed in conjunction with air brake without brake shoe and wheel damage; and better train handling in slack action.

The advantages of dynamic braking can be obtained by addition of very little equipment not required for traction purposes, "so that capital investment is relatively insignificant," the engineers stated.

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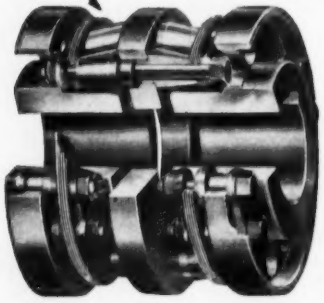

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### Longer-Lasting Lube Research

Discovery of a chemical phenomenon, claimed to make possible longer-lasting lubricants, is described in a research report now available from the Office of Technical Services of the Department of Commerce.

A big factor in deterioration of lubricants is the self-oxidation process. Heat intensifies this process and makes it difficult to prepare lubricating compositions which will stand up under long storage in warm places and withstand high operating temperatures. Furthermore, certain ingredients of lubricating compositions accelerate the self-oxidation process and are called "pro-oxidants". Other ingredients inhibiting the process are called "anti-oxidants".

Scientists conducting the research found that certain compositions, having both types of pro-oxidants and anti-oxidants, stood up against deterioration by heat. Investigating, they found that when certain anti-oxidants are present alone in a composition their inhibiting effect is very weak. However, when certain pro-oxidants are also present, they found that the inhibitant effect of the anti-oxidants instead of being decreased becomes very strong.

The pro-oxidants in this case are lithium soaps, and the anti-oxidants are certain types of organic compounds of silicon. It is stated in the report that various special application lubricants such as "greases, detergents, oils, diesel lubricants, anti-corrosion oils, turbine oil and extreme pressure gear oils—can now be made which have both longer shelf life and longer operating life."

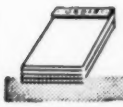
### Robert Cass, New SAE President

Robert Cass, assistant to the president of White Motor Co., Cleveland, Ohio, was installed as 1953 president of the Society of Automotive Engineers at the organization's annual business meeting in Detroit. He succeeds Dr. D. P. Barnard of Standard Oil Co. (Indiana).

Following is a partial list of 1953 vice presidents elected:

Diesel Engine: J. W. Pennington, Koppers Co., Inc.; Engineering Mate-

(*Continued on page* 80)

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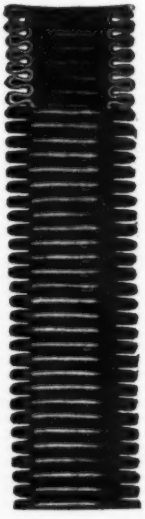

Diesel Bulletins 1020 & 50A furnish complete information.

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## *Tools and Equipment For Greater Plant Efficiency*

(*Continued from page 48*)

portation in picking up the rags and delivering them again. We found that this could be handled by the truck that makes routine calls on the plants.

We have discovered that with this type of laundry we have a net saving of about $1200 per year in rags alone. Also, we are using a much better grade of rag than we did in the past, which of course pleases our operators very much.

### Electrical Testers

We have talked about tools and shop equipment, but so far not a word has been said about instruments for checking electrical troubles. I assume that all plants have good meggers to check generators and for occasionally checking out of bad control circuits. Also, you can use a multi-meter to good advantage to check your voltages, both AC and DC, as well as resistances.

Another handy meter is one with which you can check the loading on individual motors on your auxiliaries. If these loadings are taken periodically and recorded, you can check loads against what they were six months or a year ago. This will often give you an indication of bearing wear or mechanical failure that is developing in your pump or motor. This warning makes it possible to schedule repairs at your convenience rather than wait for a failure and have to repair it when the motor has burned up or the bearing failed completely.

Another handy gadget to have around the plant is an industrial analyzer or the equivalent. Your line crew probably has one, and if you can borrow it, it is not necessary to duplicate the equipment. If your duty includes servicing transformers and circuit breakers you will need some service available or your own equipment for reclaiming transformer and circuit breaker oils. Another necessary instrument is one for testing the dielectric strength of the oil so as to check deterioration before you have a failure.

### Briefly Reviewing

As mentioned earlier, I have "skirted the fringes" of the major problems of power plant operation to bring you some of the practical ideas and equipment that have made the main job easier, contributed to the overall economy of operation, and improved the reliability of the installation. The big things usually get taken care of and it is the so-called small things that frequently cause the big headaches.

Don't forget, before you plan any project, be sure that you evaluate all the factors that have been brought out. It is foolish and expensive to duplicate facilities that are nearby. Make sure that each project will show better and/or cheaper results and will contribute to the aim of the plant—improved service.


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That's what Captain Charles H. Cates, owner of the tug Charles H. Cates VII—which has been in continuous service in Vancouver harbor since September, 1949—thinks about the S-N heavy duty **herring-bone** reduction gear and **double cone clutch** that transmits power instantly and simplifies maneuvering. "We do a great deal of harbor work", says Captain Cates, "and I would definitely recommend S-N MARINE GEARS for tugs."

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## Corrosion Is Measured Electrically Without Weighing

Recent laboratory studies by the National Bureau of Standards proved for the first time that rate of weight loss of steel corroding normally in soil can be measured electrically without actually weighing the metal. The study gives evidence that the electrochemical theory of corrosion applies generally to soils.

Although the NBS measurements were restricted to the laboratory, the success of the work suggests possibility of practical application, such as determination of the corrosion rate of a tank or other underground structure without need for visual inspection. Other advantages in addition to obviating need for excavating the underground object, were claimed.

In some soils ferrous metals corrode at a constant rate, but in others, corrosion gradually slows and may sometimes cease. Actual weighing indicates how much total corrosion has occurred but does not show how rapidly. The electrical method measures present corrosion rate which is likely to be of more practical interest than the history of past corrosion. Furthermore, it does not involve removal of corrosion products which often inhibit corrosion.

## American Companies Aid Dutch In $15 Million Diesel Program

An agreement among three American and three Dutch manufacturers was announced in which the American companies will provide technical assistance for the construction in Holland of 100 diesel-electric locomotives for the Netherlands Railways, at a total value of about $15 million. Units will be American in design except for couplings and buffers.

Westinghouse Electrical International Co. will work with HEEMAF of Hengelo, a Westinghouse licensee. Baldwin - Lima - Hamilton Corp., through HEEMAF, will work with Allan of Rotterdam. National Supply Co. will work with Machinefabriek of Hengelo.

This will be the final step in modernization of the lines begun in 1949, and will free them, when complete, from the necessity of buying coal in dollar areas, F. Q. Den Hollander, president of the Netherlands Railways revealed. "We also expect to get at least twice the power out of every dollar spent on diesel oil that we get now from dollars spent for coal," he added.

## New Nordberg Distributor

Just Equipment & Supply Co., Ltd., Montreal, Quebec, has been appointed industrial and marine distributor for Nordberg type 4FS diesel engines in the Province of Quebec, it was announced. The company is also distributor for equipment manufactured by Murphy Diesel, J. I. Case, Tull, Joy, Craig Bit, and Vogo Bros.

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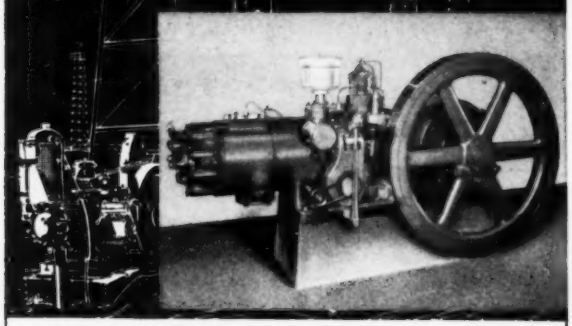

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## Gas Turbine a Challenge?

The gas turbine is seen as the only possible challenger to diesel-electric power for railroad trains, Charles Kerr, Jr., a transportation engineer of the Westinghouse Electric Corp., told the American Institute of Electrical Engineers at its meeting in New York, recently.

However, with the diesel having "the best operating characteristics the railroads ever have had for application to any and all types of service," Mr. Kerr declared that the gas turbine engine "can only succeed if it proves to be a better and more economical prime mover for locomotive service." Railroads need not fear the gas turbine locomotive making inroads on the diesel, he continued, "for nothing produces progress like competition".

## World Combustion Conference To Include United States Papers

The International Internal Combustion Engine Congress to meet in Milan, Italy, April 13-18, will have on its program a paper entitled, "Production and Utilization of Residual Fuel," prepared by R. E. Albright, C. E. Habermann, and R. B. Killingworth of Socony-Vacuum Oil Co. Also scheduled to be discussed is a paper by J. M. A. van der Horst of the Van Der Horst Corp. of America, technically under Netherland sponsorship. Title of this paper is, "The Utilization of Heavy Fuel in Diesel Engines With Porous Chrome Plate".

This is the second meeting of the Congress, theme of which is "The Use of Heavy Liquid Fuels in High and Medium Power Diesel Engines." The first meeting was held in Paris in 1951. This year Germany, Belgium, Denmark, Spain, the United States, France, Great Britain, Italy, and the Netherlands, are participating.

## Largest Order for High Voltage Transformers to Allis-Chalmers

What is believed to be the largest order of extra high voltage transformers ever placed in the United States has been awarded to the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

To supply power for their huge new Portsmouth, Ohio installation, the Atomic Energy Commission has ordered six 100,000-kva, 3-phase, 333,000/13,800-v transformers and 150,000-kva, 3-phase 330,000/13,800-v auto-transformer. Total value of the order is over $3½ million.

The six transformers include ±10 per cent load ratio control and will be forced oil, air cooled. The auto-transformer will be about 32-ft high and approximately 20-ft square and will weigh 473,000 lb. Shipment is scheduled for 1955 and 1956.

## Alco Offers Apprenticeships For Junior Engineers

In answer to the growing need for young men with specialized training, the locomotive division of the American Locomotive Company, Schenectady, New York, has established a two-year course of instruction, including scheduled shop experiences with related classroom work.

Men with proper aptitude and educational background are selected and given an opportunity to qualify themselves for permanent employment in supervisory positions. Recruits are not

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The program is divided into two main categories: basic training and specialized training including job try-out. Basic training is identical for all and is intended to furnish well-rounded education in the company's set-up. Upon completion of this first year, each Junior Engineer is given vocational guidance aided by a series of preference tests to determine which phase of specialized training he will follow. He is then given a job try-out in the department he chooses and at the end of this year, is permanently placed.

## Professor Gets Suggestions On Use of "Memory Metal"

In the November issue of DIESEL POWER, we ran an item on the discovery by a Columbia professor of a gold-cadmium alloy which can easily be bent when cold but straightens up to its original shape when heated to 150°F. According to the Professor, four uses have been proposed: (1) a fire detector, (2) a detector of overheated electrical circuits, (3) a detector of over-heated journal bearings, and (4) a material for automobile fenders.

Professor Read points out that the biggest objection to wholesale use of the strange alloy is that it contains 65 per cent carat gold—an expensive ingredient. Also, continuous exposure to temperatures of 125°C and above apparently causes the metal to lose its rubbery properties and little is known of the wearing qualities of the alloy.

## Vanadium-Alloys Buys In Canada

Vanadium-Alloys Steel Co., of Latrobe, Pa., has announced the purchase of Murray Steels Limited of Toronto and its reorganization under the name Vanadium-Alloys Steel Canada, Ltd. Also announced was the purchase of a plant in London, Ontario. Plans have been made for its early renovation and reopening for the manufacture of tool and speciality steels.


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"AMERICA'S FINEST DIESEL COMPONENT REBUILDERS"


### Porter Buys Watson-Stillman

In a move to further diversify its manufacturing operations, H. K. Porter Co., Inc., Pittsburgh, has purchased the Watson-Stillman Co., Roselle, New Jersey, manufacturers of forged steel fittings and hydraulic equipment.

In little more than two years, Porter has expanded its operations into rubber, steel, electrical equipment, and forged steel fittings by acquiring Quaker Rubber Corp., Connors Steel Co., Buffalo Steel Co., and Delta-Star Electric Co.

### England Uses Diesels To Power Dam Construction

Forming part of the Claerwen-Elan Valley water conservation plan in England, the new Claerwen Dam was recently opened. The reservoir contained by the dam will increase present water supply in Birmingham by almost 10,625 million gal.

Power for the constructional plant was obtained from a temporary generating station at the site, containing among the generating equipment two diesel-electric engines of the 4-cyl, turbo pressure-charged type 4 SK engines. Each gives a continuous output of 330 bhp at 600 rpm and has a bore and stroke of 10 in and 12 in respectively, with a mean piston speed of 12,000 fpm.

Load on the engines has been considerable; at times the two 4 SK sets were run at up to 17½ per cent overload for periods of several hours, with momentary peak loads well beyond this figure. Cause of overload was mainly the simultaneous working of two 10-ton cableways used for removal of rubble and for pouring of concrete into the foundations and structure of the dam. Other equipment drawing power from the station were a stone crushing plant, batching plant, conveyors, winches, and five main compressors.

### DuPont Engineer Gets Award

L. F. Dumont, research engineer in the petroleum laboratory of E. I. duPont de Nemours & Co., Inc., received the SAE Horning Memorial Award at the 1953 annual meeting in Detroit. His 1951 SAE summer meeting paper, "Possible Mechanisms by which Combustion Chamber Deposits Accumulate and Influence Knock," was judged the best paper relating to the adaptation of fuels to internal combustion engines, or the adaptation of internal combustion engines to fuels.

Dumont joined duPont in 1948. As leader of the scavenging research group, a position he has held since 1950, he supervises engine research on combustion chamber deposits problems.

### World's Largest Freight Car

A freight car, claimed to be the largest in the world, was recently placed on the rails at Altoona, Pa. It is a 3-unit car, with 32 wheels and 124½-ft long, and is designed to carry very large or tall and heavy shipments, such as engines and turbo-generators.

The central unit of the car where the load rests, has a lowered platform to provide clearance for high loads. It has no wheels but is supported at either end by a truck unit having 16 wheels.

### Industrial Fellowships Offered

Armour Research Foundation of the Illinois Institute of Technology is offering a number of industrial research fellowships in a graduate program leading to advanced academic degrees. Research fellows will attend the Institute half-time and work in the Foundation half-time.

Fellowships begin with the school semester in September, 1953 and continue for approximately 21 months until the end of the second academic year in June, 1955. Awards are made on a competitive basis to U. S. citizens under 28 years of age holding a bachelor's degree from an accredited engineering or scientific school or liberal arts college with a major in the sciences.

### SAE Fuels and Lubricants Meeting Held at Tulsa

Consideration of technical reports covering progress in the continuing engineering effort to match engines, fuels, and lubricants, were featured in the Society of Automotive Engineers' National Fuels and Lubricants Meeting held at Tulsa, Oklahoma. Fuel knocking tendencies caused by combustion chamber deposits, correlation of lubricating oil engine test procedures, experience with synthetic lubricants, and the fuel requirements of military vehicles were among subjects considered.

Special interest was attached to the technical reports on winter use of synthetics, which involves blending with natural oils for the lubrication of both gasoline and diesel engines. Of equally wide interest was the paper on combustion chamber deposition and knock. Combustion chamber deposits apparently increase antiknock requirements as rapidly as fuel can be improved, and it is believed that power production could be increased by raising compression ratios, were the deposition problem once solved.

## Organizational News

### Walter Kidde Promotion

Charles W. Knowles has been appointed senior vice president of Walter Kidde Constructors, Inc. Formerly vice president and general superintendent, he has been with the company for 27 years and succeeds Walter S. Wainwright who has retired.

### Kewanee-Ross Chairman Dies

Charles H. Currier, 66, chairman of the board of Kewanee-Ross Corp., died suddenly in Buffalo, N. Y.

Mr. Currier became chairman of the corporation when Ross Heater & Mfg. Co., Inc., of which he was president, was recently joined with Kewanee-Boiler Corp. He began his association with Ross Heater in 1934 as vice president. He had previously been president of Drying Systems, Inc.

### Arma Advancement

Allen W. Walz has been advanced by Arma Corp., subsidiary of American Bosch Corp., to executive staff assistant to Clifton T. Fozz, vice president of engineering.

Mr. Walz, since leaving the staff of Yale University several years ago, has

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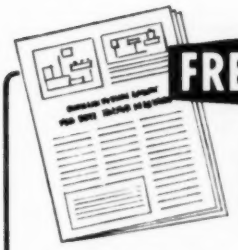

FREE

**How to layout Diesel Engine Cooling Systems**

This helpful article is the kind of factual "refresher" that a technically-minded man likes to review from time to time. At the start, it lists and describes the 4 basic requirements for Diesel Engine Cooling Systems. Then follows a discussion of the two types of systems generally used.

In the discussion of each type, you'll find a general description, typical flow diagrams, and comments on the principal advantages and disadvantages. By studying the diagrams and comments, you'll be greatly aided in picking the cooling system best suited for any particular diesel engine installation.

The article closes with suggestions on how to get the most out of various equipment in cooling systems.

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The operating coil circuit is not electrically connected to the heavy contact circuit so that different voltages and current can be used across the heavy contacts from that of the operating coils which are wound for the service required. Variations of this unit are manufactured to fit your needs.

*For further information write for Bulletin 410*

**SYNCHRO-START PRODUCTS, INC.**
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**Skokie, Illinois**


been administrator of technical personnel. His executive position is newly created, made necessary by backlog of orders requiring engineering design and development work.

### New Scaife Chief Engineer

Carl E. Johnson, a veteran of 19 years of service as engineer at Scaife Co., Oakmont, Pa., has been appointed chief engineer.

Mr. Johnson's new responsibilities will include engineering functions in connection with all new products and processes, and plant improvements, as well as supervision of all engineering activity. Prior to joining the company, he served as a mechanical engineer with the Buhl Foundation, Pittsburgh.

### Honeywell Managerial Post

Paul B. Wishart has been appointed to the newly created position of general manager of Minneapolis-Honeywell Regulator Co. and elected to the board of directors. He continues as vice president.

Mr. Wishart has been with the company for 11 years and has been vice president in charge of manufacturing since 1945. Prior to joining the company, he spent 19 years in various phases of the automotive business.

### Manager for Cleveland Diesel

Tom E. Hughes has been named general manager of the Cleveland Diesel Engine Div. of General Motors to succeed George W. Codrington who is retiring after 36 years of service with the corporation.

*Tom E. Hughes*

Hughes, 42, has been assistant general manager of the division since 1951. He entered its employ in 1933, working as a test engineer until 1935. In 1936 he was transferred to the engineering department. In 1937-38, he was engaged in service engineering work on the development of the diesel railroad engine. He later was transferred west as service and engineering representative to the Navy. He was assigned to Washington, D. C. in 1939 and in 1941 was made manager of that office. In 1946, he was transferred back to Cleveland as general sales manager and became assistant general manager in 1951.

### Borg-Warner Appointment

J. C. Kuhn has been appointed vice president, sales, of the Atkins Saw Div. of Borg-Warner Corp., according to a recent announcement. He was formerly vice president and director of sales of Morse Twist Drill and Machine Co.

### TOCCO Manufacturing Head

O. M. Marquardt has been named manufacturing manager of the TOCCO

O. M. Marquardt

Div. of the Ohio Crankshaft Co. He came to the organization in 1948 from the Budd Co. Formerly, he had been associated with GE in Detroit.

### New Allis-Chalmers Post

W. L. Voegeli has been appointed to the newly created position of assistant director of engineering, Tractor Div., of the Allis-Chalmers Mfg. Co., Milwaukee. He will assist A. W. Van Hercke, vice president and director of engineering.

Mr. Voegeli joined the company in 1935 and became supervisor of the technical publications department in 1946. He was appointed agricultural tractor sales manager in 1948.

### Alco Elevates Engineers

Alexander Ross has been appointed chief engineer and H. R. Sennstrom, executive engineer of the American Locomotive Co., it was just announced.

Mr. Ross has been associated with the company and its Canadian affiliate, Montreal Locomotive Works, Ltd., since 1932 when he joined the engineering department at Montreal. In 1941 he was placed in charge of locomotive engineering, a post he held until 1945. He was transferred to Schenectady as assistant to the director of locomotive engineering in 1946 and became engineer in charge of locomotive design in October, 1952.

Mr. Sennstrom joined Alco's engineering department in 1940, specializing in laboratory and diesel engine development work. In 1946 he was named superintendent of the diesel engine laboratory, and in 1949 he was appointed research and testing engineer in charge of all laboratory work. He directed pioneer work in the use of the spectroscope in analyzing diesel engine lubricating oil in locomotive maintenance.

Alexander Ross

H. R. Sennstrom

### Dravo Promotes Pearce

Dravo Corp. announces the appointment of D. Russell Pearce to the position of assistant purchasing agent of its Machinery Div. He joined the company in 1936 as a sales correspondent and was appointed buyer in the purchasing department in 1939.


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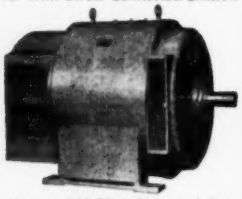

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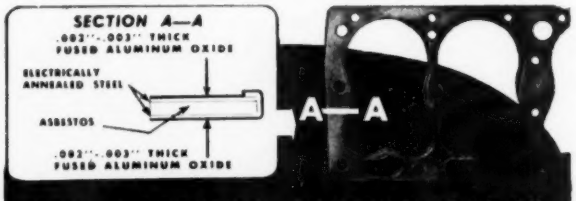


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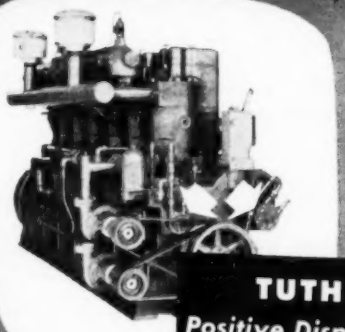

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## Fairbanks, Morse Changes

Fairbanks, Morse & Co., Chicago manufacturers, announce the following changes in personnel:

W. E. Watson, manager of the Pump Mfg. Div., has been promoted to assistant to the manager of manufacturing with headquarters in Chicago.

Paul R. Flood, manager of manufacturing of the company's Beloit, Wisc. works, has been appointed general manager of the Pomona Pump Works in California, succeeding Charles L. Barrett who becomes a consultant to the Pump Div.

Lewis H. Kessler has been named chief hydraulic engineer at the Beloit Works, succeeding R. C. Glazebrook who is on special assignment to the general manager.

Robert B. Craig, formerly R.E.A. deputy administrator and DEMA representative, has been appointed assistant to the president working on special assignment.

S. L. Fry, formerly manager of the Omaha branch diesel dept., has been appointed assistant manager of the Pump Sales Div. with headquarters in Chicago.

## New Hilliard Vice President

T. A. LaBrecque has been elected a vice president of the Hilliard Corp. He will also continue as manager of the Purifier Div., in charge of sales and engineering.

Mr. LaBrecque has been associated with the company since 1926, specializing in the application of oil purifiers. He is a member of the American Society of Mechanical Engineers and the Society of Automotive Engineers.

*T. A. LaBrecque*

## B. S. Cain, GE Engineer, Dies

Basil S. Cain, 53, one of General Electric's top locomotive design engineers who was cited by the American Society of Mechanical Engineers as an outstanding authority on locomotives, died suddenly of a heart attack.

Mr. Cain recently made two extended trips to Australia in connection with conversion of important government owned railroads to diesel-electric operation. The diesel-electric locomotives now under construction by GE for the Queensland Government Railways, were designed by him.

Mr. Cain was born in Manchester, England and began his engineering career as a student apprentice with the British Thomson-Houston Co., an English affiliate of GE. He came to the U. S. in 1923. A widely-known technical writer, he authored the book, "Vibration of Rail and Road Vehicles" and wrote many articles on the design and operation of locomotives for the technical press.

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## Caterpillar Promotes Engineers

Norman E. Risk and Richard S. Frank have been named assistant chief engineers at Caterpillar Tractor Co., topping a series of 24 promotions in the engineering department.

Risk will be in charge of the administration of design and development of crawler tractors. He joined the company in 1926, advancing to his present position from supervisor of tractor transmissions and final drives. Frank will be in charge of the design and development of diesel engines. Coming to the company in 1936, he became supervisor of engine design in 1941 and since 1950 has been a general supervisor of engine design.

## National Supply Co. Promotes

Vernon L. Durrstein, special design engineer of the National Supply Co. in the engine division, has been appointed assistant chief engineer of that division, with headquarters at Springfield, Ohio.

Prior to joining the organization, Mr. Durrstein served as a design engineer with the Cummins Diesel Engine Co., and as assistant chief engineer with the Buda Co. He is a registered engineer in Ohio and an active member of the Society of Automotive Engineers.


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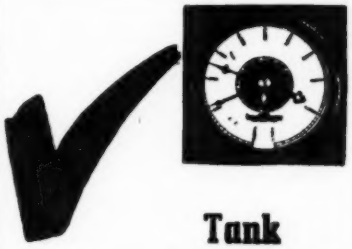

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## What Do You Know!

*(Answers to questions on Page 40)*

1. Correct answer is "a". Several modern engines can be readily converted without altering major components, compression ratio, etc. For the gas version of such an engine see the article on Page 52.

2. All three are correct. "a" and "c" are conventional structural changes. "b" is a method of altering the "effective" compression ratio peculiar to specific engines. See article above.

3. Correct answer is "b". For various criteria that must be considered see article on Page 46.

4. "c" is incorrect. Peak pressures are smoothed out. See the article on Page 49 for more details.

5. "d" represents the approximate chemical requirements. In practice, about 50 per cent additional is provided. See article on Page 54.

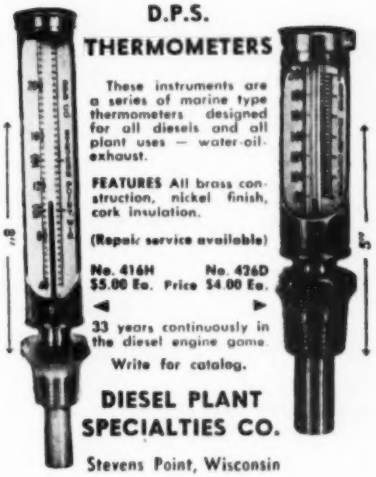
6. Correct answer is "a". This and other details are discussed in the article mentioned above.

7. "a" and "c" are correct. Volume delivered and pressure are mostly dependent on orifice size. For discussion see article above.

8. The effect of "c" will result in "d". By increasing pump speed or installing a booster station, pressure can be increased up to the safe limits of pipe strength. See article on Page 38 for an example.

9. Correct answer is "c". Fluids are supplied to the pump suction from the pumping station ahead. The amount of "boost" given in the pump is the differential pressure. See the article mentioned above for details.

10. Correct answer is "b". Aldehydes increase and decrease percentagewise with the air-fuel ratio. With a diesel operated for long periods with poor ventilation, aldehyde smells would give warning. See the article on Page 60 for details.

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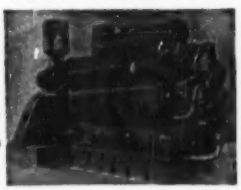

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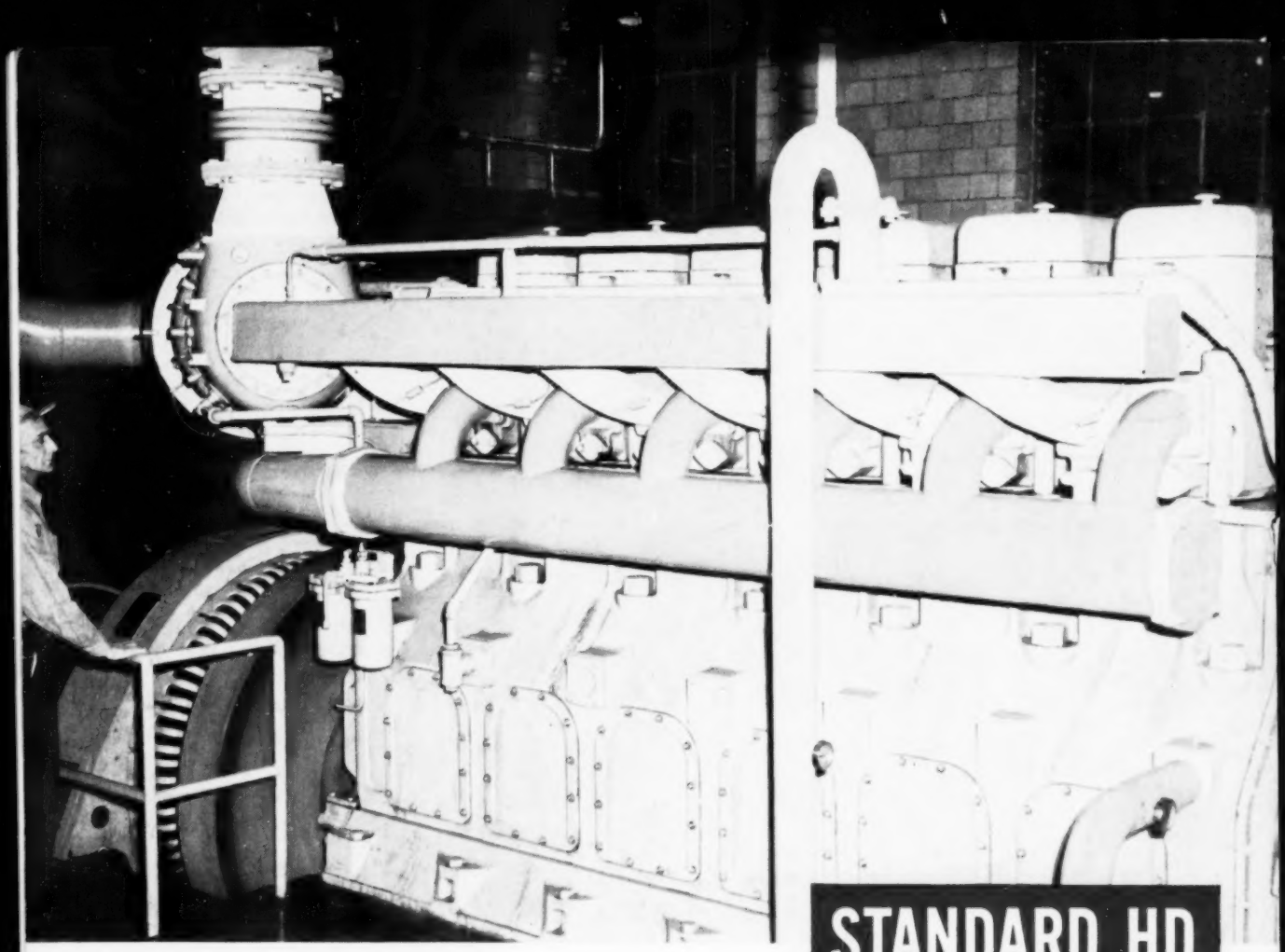

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